Advisory Committee on Acoustic Impacts on Marine Mammals

Sponsored by the Marine Mammal Commission

Fifth Plenary Meeting
April 19-21, 2005

Silver Spring, Maryland

FINAL
Meeting Summary
For Advisory Committee Review and Comment

September 23, 2005

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Advisory Committee on Acoustic Impacts on Marine Mammals

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Final Meeting Summary

The fifth meeting of the Advisory Committee on Acoustic Impacts on Marine Mammals was held on April 19-21, 2005 in Silver Spring, Maryland. The Advisory Committee, convened by the Marine Mammal Commission, is comprised of a diverse group of representatives of entities that produce sound in the marine environment, government agencies with responsibilities or activities significant to marine mammals, academic researchers, and non-governmental environmental and animal welfare organizations. The objectives of this meeting were to:

- review and discuss draft products developed by Subcommittees and Working Groups;
- develop a preliminary working list of recommendations; and
- establish a process for finalizing and endorsing the Committee's final report.

What follows is a summary of the presentations and discussions at this meeting. This meeting differed from previous plenary meetings in that Committee members spent considerable time in caucus and other small group discussions in an effort to reach agreement on and articulate key points. This summary will reflect the plenary discussions and presentations, including caucus presentations to the Committee and plenary discussion of the caucus sessions.

DAY ONE – Tuesday, April 19, 2005

Welcome and Introductions

Suzanne Orenstein, ***Facilitator,*** opened the meeting by inviting Committee members and their alternates, Committee staff, facilitators, and observers to introduce themselves. A list of meeting attendees is attached (Attachment A).

David Cottingham, Executive Director of the Marine Mammal Commission, welcomed participants to this fifth plenary meeting, and emphasized that once again, a great deal of progress was made in the interim by the Subcommittees and Working Groups since the fourth plenary meeting in December. He encouraged Committee members to recognize, value, and move forward from this interim work. He also informed the Committee that it would have the opportunity to hear from Congressional staff at this meeting regarding how they use reports such as the one the Committee is developing and what they would find most useful in the Advisory Committee's product.

Agenda for this Meeting

Suzanne Orenstein briefly reviewed the goals of the meeting and the proposed agenda for accomplishing them. The overall process described was to share general comments on the overall draft report, and then to look more carefully at specific sections. She noted the agenda was designed to bring the Committee to the point of discussing recommendations, the endorsement process, and a vision for implementation on the third day. Next steps would be to work towards planning for final meeting and Advisory Committee product.

Ms. Orenstein went on to note several challenges that the Advisory Committee might face in working with the draft documents that make up the overall draft report for discussion at this meeting. These included:

- Uneven levels of involvement among Committee members in the development of different draft documents. Some have spent many hours and are very familiar with particular pieces of the report, and have worked hard to achieve agreement of Working Group or Subcommittee members. Others are discussing the documents for the first time. Discussion of the various pieces at this meeting should focus on enhancing these products.
- Matching the current draft documents to the goals of the Advisory Committee. In discussing these drafts, Committee members should be asking whether they represent what was asked for or envisioned, and whether they are still what is needed.
- Maintaining a focus on what Committee members can agree on, and not losing site of the agreements to date.
- Addressing disagreements. The Committee will need to determine how it wants to manage and reflect any disagreements.

To address these challenges, Ms. Orenstein urged Committee members to focus clearly on the goals and to both seek and be open to alternative ways to achieve them. She encouraged each interest group to be clear and consistent about its priorities. She indicated that the use of small groups may be needed at times during the course of the meeting in order to draft language and resolve specific disagreements.

Regarding the status of the Draft Report under discussion, Ms. Orenstein reminded everyone that it is not yet a Committee product. It remains a compilation of the work of various Subcommittee and Working Groups in which some degree of agreement was reached. She emphasized that there is no agreement on the document until the full Advisory Committee agrees on all of it, in its entirety. She noted that it is especially important for Committee members and for the others who are involved or observing the process to recognize the tentative nature of the documents.

Ms. Orenstein went on to lay out a possible process and timeline for finalizing the report following this meeting, assuming a final Advisory Committee meeting in July. However, she noted that the proposed schedule will depend heavily on the outcomes of this meeting and will almost certainly be revised as a result.

Fourth Plenary Meeting Summary

Lee Langstaff, Facilitator, noted that very few comments were received on the draft summary of the fourth plenary meeting, most of which were editorial. She inquired as to whether Committee members had any additional comments on that summary. One Committee member requested revised language to one sentence and this was accepted and agreed to by the Committee. With this change the summary of the fourth plenary was agreed upon and finalized. The summary will be placed on the Commission's website: http://www.mmc.gov/sound.

General Discussion of Draft Final Report

In order to begin the general discussion of the overall Draft Report, Ms. Orenstein directed participants to a summary list of issues raised by different interest groups in discussions with the facilitators prior to the meeting regarding their impressions and concerns about the current draft pieces of the Draft Report (see Attachment B). Committee members were invited to identify any additional comments or concerns regarding the Draft Report overall that were not reflected in the summary list of issues from discussions with the caucus groups. In response, various Committee members made the following points:

- The report is missing a compelling statement of concern. The current tone of the document will not encourage anyone to care about the issue. This should be addressed in the introduction.
- The focus should be on mitigation that makes sense.
- There needs to be a clear statement of what regulatory bodies should do.
- Adaptive management needs to be highlighted – to address the effectiveness of mitigation and provide feedback to improve it.
- The management and mitigation recommendations are too broad and vague and should be made more specific and robust.
- Use of terminology needs to be consistent (*e.g.*, noise versus sound; impacts versus adverse effects), and how we use peer reviewed references should also be consistent.
- The document should define what should be done today and not limit action because of uncertainty.
- There is a need for a shorter summary of the state of current knowledge.
- It is essential to develop an Executive Summary. The rest of the report can and should be as long as it needs to be to back up the "road map" laid out in the Executive Summary.

Some members of the researchers caucus indicated that they have fundamental concerns with the current Draft Report and are frustrated by a lack of progress and frustration that the Draft Report does not address issues that are important to the research community. The researchers caucus provided a brief presentation highlighting the following specific concerns:

- The primary problem with the issue is our ignorance of how important it is for marine mammal conservation.

- The recommendations of the NRC reports should be endorsed. Those panels are better qualified to make research recommendations than this Advisory Committee. In particular the statement of the most recent NRC report stating:

  > "No scientific studies have conclusively demonstrated a link between exposure to sound and adverse effects on a marine mammal population. These considerations have led to alternative assessments of the effects of sound on marine mammals. On the one hand, sound may represent only a second order effect on the conservation of marine mammal populations; on the other hand, what we have observed so far may be only the first early warnings or "tip of the iceberg" with respect to sound and marine mammals."

- Scientific methods are available to answer most questions about effects on animals and the effectiveness of monitoring and mitigation.
- The most pressing need and most urgent message for Congress is to make the case for research funding and to make concrete suggestions for how to remove the regulatory and legal obstacles to obtaining the information required for effective management of the potential risk.
- The membership of the Subcommittee developing the Synthesis of Current Knowledge does not have the appropriate expertise to do this job.
- There is relatively little text and few recommendations of high relevance to Congress.
- There has been little movement towards resolving fundamental problems:
  - Identification of critical uncertainties regarding risk;
  - Prioritization of limited funding and regulatory effort to maximize conservation gain to marine mammals;
  - Prioritization and endorsement of critical research; and
  - Elimination of obstacles to getting answers.
- The position paper prepared by the research caucus a year ago has been largely ignored.
- The caucus is willing to continue participating in the process if there is progress at this meeting, but if not, there is interest in the caucus to develop an alternate report.

Committee members responded to the stated concerns of the research caucus with the following points:

- Several members argued that they believed that most of the issues noted are, in fact, addressed in various places in the Draft Report.
- One member indicated that it seems as if the researchers are seeking to recommend removal of all obstacles to their work and to be excused from having to do mitigation themselves.
- One member emphasized that there are two components to what the report needs to cover. The first and most important is to describe innovative management approaches to minimize risk; the second is to identify ways to eliminate uncertainty and better clarify the risk. These are not mutually exclusive, although there may be disagreement over the vision of appropriate relative emphasis between the two. This member expressed concern about placing so much emphasis on getting information first that action to manage or mitigate would be delayed.
- At least two members noted that the research recommendations from the NRC reports have been acknowledged along with research recommendations from other sources. They pointed out that no Advisory Committee members have indicated a lack of support for the

research recommendations in the NRC reports. However, some Committee members are unwilling to give wholesale endorsement of all of the NRC recommendations because they include policy related recommendations that they do not agree with and which were developed without input from other stakeholders (particularly the most recent NRC report).

- One member disagreed with the quoted statement from the NRC 2005 report, noting that it simply ignores the historical use of sound in drive fisheries that intentionally and successfully use sound to move whole groups of marine mammals.
- One member noted that the researchers are just one element of this multi-stakeholder Committee, and stated that the report should be policy-oriented.
- Two other members objected to the suggestion that researchers are the only ones qualified to set research goals.
- One member pointed out that this discussion lays out a central problem: that the document as it currently stands will not get Congress's attention and does not do what caucuses want it to do. While we may not agree on all the substantive issues, we do have a common interest in getting a report to Congress that is read and considered.
- One member expressed support for focusing on what Congress can provide: resources for scientific research and mitigation.
- One member expressed the belief that the chapter on Synthesis of Current Knowledge is very useful and is, in fact, consistent with NRC reports. He indicated that it may be difficult to agree on research priorities because there are different interests to be met

Ms. Orenstein summarized the discussion by noting that there seems to be general agreement that the message needs to be sharpened so that it will get people, particularly Congress, to pay attention. This could be accomplished by developing a clear statement of the problem and an Executive Summary that tells the story and makes a compelling case for addressing the topic. Further, there seems to be agreement that the two major thrusts of the Committee's report should be: 1) getting needed information regarding risk, and 2) effective mitigation of that risk. Both of these are described in the charge to the Committee and are addressed in the Draft Final Report.

At this point Committee members agreed to break and meet in caucus groups before continuing discussion of the Draft Report. They agreed that each caucus would return with their input identifying the most important points regarding:

1) a statement of the problem,
2) the information needed to reduce uncertainty and inform the management system, and
3) sensible steps for what we do now (*e.g.*, mitigation and management).

Caucus groups included: government agencies (including regulatory agencies and regulated agencies), industry sound producers (oil and gas, shipping), science and research, and environmental (conservation and animal welfare). Summaries and presentations made by the groups are available from http://www.mmc.gov/sound.

Reports from Caucus Groups

Report of State and Federal Agency Caucus

1) State and Federal Agency Caucus Key Points for Statement of the Problem:
   - Large uncertainties in all areas of the issue fuel public controversy

  - Stranding causes (acute and systemic)
  - Behavioral responses of different species
  - Effectiveness of management and mitigation
  - Difficult to assess population-level effects (use individual-level effects as surrogate)
- Acute problems with beaked whales and mid-frequency sonar
- Potential impacts of environmental compliance and uncertainties to (1) research, (2) security, and (3) economics.

2) State and Federal Agency Caucus Key Points Regarding Information Needs
- Fill information gaps (including baseline information):
  - Marine mammals (populations, distributions, behavior, anatomy, etc)
  - Sound sources (ambient levels, source characteristics and distributions, etc)
  - Effects/Level of risk (behavioral and physiological impacts, etc)
  - Management and mitigation (effectiveness, risk assessment methods, etc)
- Fund the research/information gathering:
  - Partnerships like NOPP
  - Stock assessments
- Adopt permitting and authorizations appropriate to level of risk and what is known now
  - Streamline processes

3) State and Federal Agency Caucus Key Points Regarding Sensible Mitigation and Management
- Current mitigation and management are best that can be done with existing information
- Evaluate effectiveness of mitigation/management strategies
- One size does not fit all
- Incorporate new information as it becomes available
- Public perception and education

Report of Environmental/Animal Welfare Caucus

1) Environmental/Animal Welfare Caucus Key Points Regarding Statement of the Problem:

There is compelling evidence that increasing levels of anthropogenic sound are adversely affecting marine mammals. Therefore there is an urgent need for precautionary management. Marine mammals are difficult to study and rely heavily on sound; in addition, the marine environment is complex, and population effects are difficult to detect. While research is needed to refine management, action cannot wait for scientific certainty. Various international bodies have acknowledged all of this in recent years.

2) Environmental/Animal Welfare Caucus Key Points Regarding Information Needs:
1. Research on distribution, abundance, and habitat use and identification of biological hotspots
2. Development and research on alternative technologies and source level reduction
3. Standardized, systematic data collection from all available platforms and independent analysis, made available to the public
4. Identification and monitoring of acoustic hotspots

5. Monitoring measures to ensure greatest possible detection and analysis of strandings and deaths at sea coincident with noise

3) Environmental/Animal Welfare Caucus Key Points regarding Sensible Mitigation and Management:

1. Geographic/seasonal exclusions
2. Source reduction or elimination
3. Operational restrictions, including as a matter of priority, temporal restrictions, best practice safety zones (3km), trained marine mammal observers, and passive acoustic monitoring

Report of Sound Producing Industry Caucus (oil and gas, shipping)

1) Industry Caucus Key Points for Statement of the Problem:

- Marine mammals are potentially affected by sounds generated in the oceans
  - Compared to other anthropogenic impacts on marine mammals, we believe sound is a second order effect
  - No scientific studies have conclusively demonstrated a link between exposure to sound and adverse impacts on a marine mammal population. (NRC '05)
  - For sounds generated by industry:
    - There are no known injuries to marine mammals
    - There are no known behavioral effects that have led to population level impacts.
- There is disagreement as to the extent of the problem among stakeholders.

2) Industry Caucus Key Points Regarding Information Needs:

- Generate additional information to refine/populate risk assessments:
  - Acoustic sound source characteristics and propagation from sound sources.
  - Specific sensitivity of marine mammals to sound and potential for physical impacts to the animals.
  - Behavioral reactions of marine mammals to sound, and whether it is biologically significant.
  - Practical and effective mitigation strategies and technologies.
  - Research tool development (e.g. auditory modeling and animal tracking technology)
- Conduct research studies that establish appropriate exposure thresholds.
- Generate information on life histories of various species, e.g. abundance, distribution, behaviors, etc.

3) Industry Caucus Key Points regarding Sensible Mitigation and Management:

- We believe in a balanced and protective approach that takes into consideration species, activities and interests, and is commensurate with the level of risk
- Continue to conduct risk assessments using the best available scientific information
  - Employ mitigation measures that manage the risk for physical injury to marine mammals
  - If behavioral effects lead to population level effects, employ additional measures specifically designed for and commensurate with the risk of the circumstance.

Report of Researchers Caucus

1) Researchers Caucus Key Points for Statement of the Problem:
   - Marine mammals are acoustic specialists.
   - We know ***individual*** animals can be adversely affected by exposure to anthropogenic sound.
   - Adverse effects of anthropogenic sound on marine mammal ***populations*** have not been scientifically demonstrated:

     "No scientific studies have conclusively demonstrated a link between exposure to sound and adverse effects on a marine mammal ***population***. These considerations have led to alternative assessments of the effects of sound on marine mammals. On the one hand, sound may represent only a second order effect on the conservation of marine mammal ***populations***; on the other hand, what we have observed so far may be only the first early warnings or "tip of the iceberg" with respect to sound and marine mammals." NRC 2005

2) Researchers Caucus Key Points Regarding Information Needs:
   - Prioritize and endorse basic and applied research recommendations
   - Diversify funding and encourage cooperation among funding entities
   - Establish a statutory and regulatory framework that protects animals while removing obstacles to research needed for conservation

3) Researchers Caucus Key Points regarding Sensible Mitigation and Management:
   - Comprehensive management applies to all sound sources – "level playing field"
   - Streamline regulatory processes to enable adding unregulated activities
   - Focus regulatory effort on activities with greatest risks
   - Consider effects of sound along with all other impacts
   - Population level most important, but should consider individual takes

The Researchers Caucus also indicated that they encourage Ken Balcomb to provide language for the Synthesis report on the known effects of drive fisheries.

The following questions and comments were noted by Advisory Committee members in response to the presentation of the Research Caucus.

Question: There is no reference to mitigation in the presentation of the Researchers Caucus. Why?
Response: Researchers have a heightened awareness of the ineffectiveness of current mitigation.

Question: Regarding adding unregulated activities to those that need to be addressed – do you assume that the regulatory process will allow for this? Some of the currently unregulated sources of sound do not come under U.S. jurisdiction.
Response: We want to point out that so many activities are not regulated when they should be (due to inertia, history, etc.). We did not really consider the legalities.

Question: Why, given what we know about population affected by the 2000 Bahamas stranding event, are we not considering that event to have had a population level effect?

Response: We know too little about population size and status in that case to draw conclusions or evaluate population level effects.
Comment: Regarding the Bahamas Cuvier's beaked whale population in the Bahamas, we had photo identified 35 members of that population over nine years. After the sonar incident, there have been no re-sightings of any of those individuals, although in the last five years we have seen some new individuals.
Comment: We need to have more discussion of population level impacts. The Bahamas case is a good example of where we are unwilling to draw conclusions even when population level effects do seem to have occurred. What information is needed to enable us to draw conclusions about population level effects and would it be practical to approach it that way?
Comment: This is probably not the right group to attempt to develop a definition of populations and population level effects, and attempting to do so will prevent us from making progress on other things we need to do.

Cross-Caucus Small Groups

Following the caucus presentations, it was generally agreed that there was a significant amount of overlap across caucuses, and that it was proposed that the Committee break into cross-caucus groups on each of the pieces (Statement of the Problem, Information Needs, and Management and Mitigation) in an effort to seek as much agreement as possible on how to approach each of these, including reflecting disagreements where necessary. This proposal was well received and Committee members broke into working sessions of three cross-caucus small groups as outlined below:

Statement of the Problem: This group was charged with developing a proposed consensus Problem Statement for consideration of the full Advisory Committee that would address the key points identified by the individual caucuses earlier in the meeting.

Information Needs: This group was charged with developing an approach to identifying information needs, drawing on the summary compiled list of research recommendations from other efforts, from the information needs identified by the Subcommittees on Synthesis of Current Knowledge and Management and Mitigation, and from the key points identified by the individual caucus groups. Specifically, their task was to

1) develop a master list of research needs or recommendations, and
2) develop a summary list of top research priorities.

Management and Mitigation: This group was charged with reviewing the latest draft of the Subcommittee on Management and Mitigation and developing a proposal for how to revise (and shorten) it to reflect the key points identified by the individual caucuses.

Work in these cross-caucus groups spanned the end of this first day and into the second day. The outcomes from all three groups are reported as part of the summary of the second day.

Public Comment

Three meeting observers offered public comment. Their comments are summarized below, and any written comments they submitted are available at http://www.mmc.gov/sound.

Mac Hawley, Hawley Family Foundation.
I would like to offer a broad perspective of the matter at hand. The earliest whale fossils are 53 million years old. Dolphin fossils with a body shape and brain case approximately the same as modern dolphins are 30 million years old. Proto-humans showed up around 1 to 2 million years ago. We are only 125,000 to 150,000 years old. Cetaceans have big brains that have had a very long time to develop; we are the ones who are new. We have the technology available to attempt acoustic communication with cetaceans, and this could be one of the great undertakings in our species' history. It is imperative that we do what we can to protect this chance. In the last 100 years, human activity has increased ambient and acute noise in the oceans dramatically. We do not understand the impact this is having on cetacean populations. However, it is not a great leap of faith to guess that our impact is negative.

The Pew Oceans Commission Report and the US Commission on Ocean Policy Report both paint a bleak picture of the oceans, largely due to pollution and over fishing.

The research needs identified by this committee represent two or three lifetimes of unfunded work ahead. We have poor knowledge of baseline population data for many marine mammal species. We know little about normal behavior, and less about the impact of chronic and acute sources of noise on this behavior. If we wait several decades for the necessary research to be performed to truly understand how to effectively mitigate human generated noise, we will be looking at a disaster in the oceans. We need to turn it down now. We need to observe the precautionary principle. We need to maintain the allowed sound standard of 120dB and not raise it to 180dB. We need to follow the guidelines set forth by NEPA, ESA and MMPA. The burden of proof for permitted activities that may cause harm must remain with the applicant.

There is an unusual alignment of interests in the U.S. Government now. A Republican administration, and a House and Senate which is strongly favorable to both the military and the oil & gas industry implies that the sound generators at this table will get to maintain their respective status quo. Sadly, this is likely to be bad for cetaceans, bad for the oceans, and bad for us. Far better would be a commitment by each sound maker to 'turn it down'. Modern technology can be a great benefit in maintaining or enhancing your mission while accomplishing this important benefit for us all.

Bill Rossiter, Cetacean Society International
I would like to speak in support of controlled exposure experiments (CEEs). We are currently trying to rely too heavily on extrapolation (*e.g.*, development of the NMFS Noise Exposure Criteria). We should take advantage of what happens every day, of the sound production that is going on already. Couldn't the Navy let researchers know where and when an event would occur (with the appropriate security clearances, etc.)? Why can't we re-define CEEs to look at sound that is already occurring? I support CEEs with caveats. Tell us exactly what you have in mind; we want to trust you. I would like to prevent lawsuits against researchers and get some real knowledge.

Lindy Weilgart, Dalhousie University.
First, in response to respond to Bill Rossiter's comments, what he is describing I would not characterize as a Controlled Exposure Experiment.

Although I am an alternate Advisory Committee member, I am giving a public comment because I was not at the table when the issue of population effects was raised in references to the statement in the 2005 National Research Council report which says that "no scientific studies have conclusively demonstrated a link between exposure to sound and adverse effects on a marine mammal populations." This is a scientifically indefensible statement, in my opinion. We know that Ken Balcomb has undertaken a nine-year study on a beaked whale population, the longest beaked whale study there is outside of our (Hal Whitehead's) lab's work on bottlenose whales. He showed that there were no re-sightings of some 35 known individuals after the Bahamas strandings occurred. That is a population-level effect, especially as, with the exception of two new individuals, other Cuvier's whales have not re-populated the area. That is the best information we have to date. It may not be a genetically distinct population but it is a local population. We cannot just discount that information unless you can show us a beaked whale population that has been similarly studied for a decade or so, and after an acoustic stranding event you can show that the population is as healthy as before the stranding. We have no such information, so Ken Balcomb's is the best information we have for these types of strandings and evidence of population-level effects. Secondly, the statement does not explain how nearly impossible it is to discover population declines in all but a handful of well-studied cetacean populations. For all but a few cetacean populations, our estimates are extremely imprecise (+/- 40% of the population estimates or worse). To tie those population declines to noise becomes even more challenging. Also, we haven't really looked for population declines associated with noise, even for pinnipeds, which are much easier to census. This statement raises the bar of finding effects unreasonably high since it implies that sound has to be the only factor in a population's decline. The only population declines that I have heard of that are linked primarily to only one factor are: a) the vaquita and bycatch; b) Eastern Tropical Pacific dolphin declines and tuna nets; and c) Aleutian sea otters and orca predation. So again, this statement standing alone is scientifically irresponsible and I hope that the Advisory Committee will acknowledge that.

DAY TWO – Wednesday, April 20, 2005

Suzanne Orenstein opened the day's session by acknowledging the hard work and accomplishments of the previous day and noting Committee members' willingness to make adjustments to the agenda in order to make progress, and pointing out that this approach may continue if the group continues to find it useful.

Congressional Staff Comments

Amy Frankel Senate Commerce Committee Minority staff member, and ***Bonnie Bruce, House Committee on Resources Subcommittee on Fisheries and Oceans Majority staff member,*** spoke with the Committee to share their views regarding what would be useful in a report to Congress on acoustic impacts on marine mammals. A brief summary of their comments is presented below.

The Report should summarize:

- What we know and don't know about "acoustic 'threats'"

- Research priorities — to provide an idea of what Congress can fund
- A menu of options for management and mitigation (this is the "means to reduce those threats" part of the Advisory Committee's charge), including "practical measures" that could be used to address threats separate from any regulatory approach (*e.g.*, development of quieter ships)
- What is going on internationally (research, mitigation, etc.), and what more could be done internationally (*e.g.*, is there an international forum that could address aspects of the issue, and/or broader marine mammal issues?)
- What agencies and others can do voluntarily, and/or under current law

Report should also:

- Provide overall rationale for Congressional attention to the issue.
- Minimize prescriptive statements (*e.g.,* about legislative changes or regulatory approaches).
- Highlight areas of agreement. The more consensus the better. Avoid conflicts about the details if the Committee can't reach consensus on them. Summarize agreements in the front of the report, and provide details in back.
- Place emphasis specifically on marine mammals, rather than other components of the marine environment.

The Committee engaged in brief discussion with the Congressional representatives and thanked them for providing their thoughts and guidance.

Reports from Cross-Caucus Groups

Outcome from Cross-Caucus Group on Statement of the Problem

This group developed a one-page Problem Statement for consideration by the Advisory Committee. In introducing it, ***Joel Reynolds, Natural Resources Defense Council*** emphasized that the group had focused on trying to reach as much agreement as possible, and only to resort to characterizing disagreements if necessary. The Advisory Committee discussed and agreed on specific revisions, resulting in the following consensus Problem Statement:

> "Marine mammals have evolved over millions of years and rely on sound for vital life functions.
>
> Anthropogenic sound in the oceans has increased since the start of the industrial revolution, and increases in ambient noise levels, as well as individual sound sources, may cause adverse effects the extent and type of which are not well understood. These sound sources include, among others, vessels, sonar operations, seismic surveys, coastal construction, acoustic harassment devices.
>
> After a series of highly-publicized strandings of cetaceans coincident with exposure to mid-frequency sonar, public concern has increased about the effects of anthropogenic sound. This emerging concern has been acknowledged by a variety of domestic and international fora.
>
> Peer-reviewed scientific literature indicates that marine mammals are affected by exposure to a range of anthropogenic sound in ways varying from inconsequential to harmful, or even

lethal. However there are significant gaps in information available to understand and manage these effects.

This is particularly the case because marine mammals are extremely difficult to study, and the marine environment is extraordinarily complex and dynamic.

Federal agencies, researchers, and sound-producing entities are grappling with problems in permitting ocean activities while protecting marine mammals. Management agencies must make decisions about how to manage these effects in the face of substantial uncertainties. While research and substantial resources are needed to refine management and better understand the effects of anthropogenic sound, there is a need to proceed expeditiously with sensible mitigation measures to address potential adverse effects without waiting for complete scientific certainty.

The Advisory Committee recognizes that anthropogenic sound is one of many threats facing marine mammals, such as fisheries bycatch, habitat degradation, ocean pollution, whaling, vessel strikes, and others. The effects of these threats may be cumulative. Consistent with the direction from Congress, we have focused only on effects of anthropogenic sound and not on other threats to marine mammals."

Outcome from Cross-Caucus Group on Information Needs

The small group proposed that the compiled list of recommendations from past efforts be revised to include recommendations relevant to mitigation. They also produced the following narrower list of categories of information needs with priorities for specific research in each.

Common categories of information needs:

A. Sound Sources and Sound Field Characterization
B. Baseline Marine Mammal Information
C. Effects of Anthropogenic Sound on Marine Mammals
D. Mitigation
E. Development of Mitigation and Research Tools

A. Sound Sources and Sound Field Characterization

- As part of standardized ocean observation networks, measure a full range of acoustic parameters in order to better understand short- and long-term trends in ambient ocean noise levels on global, regional, and local scales, and allow for the development of models of ambient noise.[1]

[1] Recommendations from Cox *et al.* in review, IWC/SC 2004, Miller *et al.* 2005, NRC 2003, NMFS in prep., Simmonds *et al.* 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.

B. Baseline Marine Mammal Information

- Conduct research on the status, abundance, stock structure, life histories, and distribution of marine mammals, developing standardized methods and identifying important geographic and seasonal trends. [2]
- Develop, test, and validate models to characterize and predict marine mammal habitat use (*e.g.*, cold spots and hot spots).[3]
- Conduct research and develop, test, and validate models to better understand the functions of marine mammal behavior, including communication.[4]
- Conduct research and develop, test, and validate models to better understand marine mammal auditory systems and hearing capabilities, developing and refining new techniques, including auditory brainstem response (ABR) methods, as appropriate.[5]

C. Effects of Anthropogenic Sound on Marine Mammals

- Conduct long- and short-term research and monitoring, and develop, test, and validate models to better understand and predict the occurrence and consequences of marine mammal behavioral responses to anthropogenic sound exposure (including tolerance, habituation, sensitization, disturbance, and habitat avoidance or abandonment), as well as the relationship of these responses to physiological effects, with particular attention to sound exposures in important marine mammal habitat.[6]
- Conduct research and develop, test, and validate models to better understand and predict the onset and consequences of temporary and permanent threshold shifts and masking, as well as the types of sound exposure that cause them and their relationship to other auditory and behavioral effects.[7][8]
- Conduct research to better understand and predict the occurrence and consequences of physiological effects from anthropogenic sound exposure, as well as the relationship of these effects to auditory and behavioral effects, including directed and opportunistic examinations of marine mammal anatomy, physiology, pathology, and strandings.[9][10]
- Conduct retrospective analyses of stranding events, including comparisons of pathologies, environmental variables, and anthropogenic sound sources present.[11]
- Conduct research and develop, test, and validate models to characterize population-level effects and biological significance of anthropogenic sound exposure.[12]

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[2] Recommendations from Cox *et al.* in review, Evans and Miller 2004, IWC/SC 2004, NRC 2003, Simmonds *et al.* 2003, and U.S. Navy 2005a support this.
[3] Recommendations from Cox *et al.* in review, NRC 2003, and U.S. Navy 2005a support this.
[4] Recommendations from Cox *et al.* in review, NMFS in prep., NRC 1994, and NRC 2000 support this.
[5] Recommendations from Cox *et al.* in review, Evans and Miller 2004, Jasny and Reynolds 1999, NMFS in prep., NRC 1994, NRC 2000, Simmonds *et al.* 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[6] Recommendations from Cox *et al.* in review, Evans and Miller 2004, IWC/SC 2004, Miller *et al.* 2005, NMFS in prep., NRC 1994, NRC 2000, NRC 2003, Simmonds *et al.* 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[7] Recommendations from NRC 2000, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[8] Recommendations from Miller *et al.* 2005, NMFS in prep., NRC 2000, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[9] Recommendations from Cox *et al.* in review, Evans and Miller 2004, Southall *et al.* in prep., and U.S. Navy 2005a, support this.
[10] Recommendations from Cox *et al.* in review support this.
[11] Recommendations from Cox *et al.* in review and IWC/SC 2004 support this.

- [Conduct CEEs] (Brackets indicate lack of agreement among cross-caucus group members.)

D. Mitigation

- Research the feasibility, appropriateness, practicality, and effectiveness of mitigation tools in various contexts.
- Investigate modification of sound sources to minimize adverse effects.

E. Development of Mitigation and Research Tools

- Develop alternative sound source technologies.
- Develop tracking and tagging technologies, ABR techniques, and controlled exposure experiments (CEEs) as appropriate to investigate effects of anthropogenic sound.[13]
- Develop methods to understand the effects of anthropogenic sound on marine organisms and ecosystems, as well as cumulative and synergistic effects of multiple exposures to anthropogenic sound and exposures to other threats.[14][15][16]

The cross-caucus group on information needs also noted that there is a need for process recommendations to facilitate research. Suggestions included a short paragraph on how best to fund needed research and/or covering this in a separate section on research issues.

Advisory Committee members generally indicated that the work on information needs is getting close to what is needed. Several members highlighted the value of the lists of research needs and recommendations that this cross-caucus group used in developing their product. One suggested that the list of needs from the NRC reports and other efforts be combined with the list of information needs that emerged from the Synthesis Subcommittee, and that those research needs related specifically to management and mitigation tools be kept separate. Another member suggested that the information needs that the Synthesis Subcommittee identified as flowing naturally from their report might be incorporated into that report, either at the end of each section or all at the very end of the chapter.

Outcome from Cross-Caucus Small Group on Mitigation and Management

Suzanne Orenstein provided a report of the discussions of the cross-caucus small group that discussed the report of the Subcommittee on Management and Mitigation. The cross-caucus group reviewed the report in light of the priorities described by the Congressional staffers earlier in the day, and suggested specific edits to the report. They suggested highlighting the unaddressed sources section, the mitigation tools section, and some of the recommendations, while reducing the text in the

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[12] Recommendations from Cox *et al.* in review, NRDC 1999, Simmonds *et al.* 2003, and Southall *et al.* in prep. support this.

[13] Recommendations from Cox *et al.* in review, Evans and Miller 2004, Miller *et al.* 2005, NMFS in prep., NRC 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.

[14] Recommendations from Jasny and Reynolds 1999, NRC 1994, NRC 2000, NRC 2003, Simmonds *et al.* 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.

[15] Recommendations from NRC 1994, NRC 2000, Southall *et al.* in prep., and U.S. Navy 2005a support this.

[16] Recommendations from IWC/SC 2004, Jasny and Reynolds 1999, Southall *et al.* in prep., Simmonds *et al.* 2003 and U.S. Navy 2005a support this.

description of the statutes. They also suggested combining the monitoring and enforcement sections. Regarding the recommendations section, the cross-caucus group recommended deleting recommendations that contain specific regulatory or statutory suggestions, and also changing some recommendations to findings.

The Advisory Committee requested that the facilitators distribute a redlined version of the report, reflecting the suggested changes, after the meeting, to more clearly describe the cross-caucus suggestions. One Committee member proposed that the task of revising the report be sent back to the Subcommittee for further work, and the full Committee agreed. The facilitators agreed to distribute a redline version and the Subcommittee agreed to continue working on the draft.

Public Comment

Sarah Jensen, Alaska Eskimo Whaling Commission[17]

The AEWC represents 10 whaling villages on the Beaufort Sea who are concerned about the ever-tightening noose of sound associated with oil and gas production. The development of infrastructure off of Prudhoe Bay, barge traffic, onshore drilling pads and platforms continues to expand. There are new lease sales, including the second of three leases bought off of the Arctic National Wildlife Refuge area near one of the whaling villages. There is increasing seismic testing and boat activity. As a result, the whales are migrating farther offshore to avoid the increasing noise and activity, making it more difficult and dangerous for Alaska natives to carry out traditional hunts. The MMPA protects marine mammals and also the livelihood and culture of native Alaskans. Vessel traffic and noise are now our biggest scare, not oil spills. If harassment definitions are changed to incorporate biological significance definitions, this will affect us negatively. Even if behavior changes are not biologically significant, they may well be significant to native whalers. Too much noise will send the whales away.

DAY THREE – Thursday April 21, 2005

Suzanne Orenstein began by reviewing the outcomes from the previous day and outlining a revised proposed agenda for this last day.

Revisions to Final Report Outline

Advisory Committee members engaged in open discussion of the ways in which they envision the structure of the Committee's final Product. There was agreement on the need for a strong Executive Summary, limited to 10-15 pages. There were differing views regarding whether the Executive Summary should constitute "the Report" with the other pieces attached as Appendices, or if the chapters should be retained as part of the body of the report (with specific revisions to be determined through further discussion), and whether these sections should be as long as they are now, or greatly shortened. In the end, informed by the input from Congressional staff, and discussions throughout the meeting, Advisory Committee members agreed on a revised outline for their Final Report as follows:

[17] Ms. Jensen's public comment was accompanied by slides showing maps of the areas of concern. Her presentation slides can be found at http://www.mmc.gov/sound.

I. Executive Summary
Include Statement of Problem

II. Introduction to report

III. State of Knowledge (what we know and don't know - based on Synthesis Report)
- Identify acoustic threats
- Strandings

IV. Management and Mitigation
(Menu of toolsand solutions, with discussion and critique)
- What doing now
- What could you do
- What needs to be developed
- Recommendations on M&M

V. Research Issues
- Research Needs and Priorities
- Permitting (highlight need for resources for permit reviews)
- Funding diversity
- Animal welfare ethics issues for directed research on marine mammals in the wild

VI. International
- International scientific efforts
- What others are doing re: management and mitigation (incl. other Navies)
- Recommendation re ongoing mechanism/forum(s) to facilitate discussion of marine mammal issues (including noise)

Discussion of the Report of the Subcommittee on Synthesis of Current Knowledge

Lee Langstaff provided an overview of the status and structure of the Draft Report on the Synthesis of Current Knowledge. (Presentation slides available on website: http://www.mmc.gov/sound.) She reviewed the charge to the Subcommittee and the agreed on vision for the product. In particular, she noted three specific protocols that the Subcommittee agreed to and which guided their development of the product. These included:

1. The use of the terms "sound" vs. "noise." The Subcommittee agreed to use the term "sound" except when explicitly referring to background noise, ambient noise, masking noise or band-limited noise. They agreed to otherwise avoid use of term "noise" because it tends to imply a judgment regarding the desirability of the sound in question.

2. Literature Cited. The Subcommittee Agreed to rely primarily on published, peer-reviewed literature to support statements of knowledge or uncertainty. They further agreed to cite gray literature or other sources when Subcommittee members agreed on quality and credibility of the source.

3. Distinguishing between Scientific Uncertainty vs. Scientific Disagreement. The Subcommittee agreed that for the purposes of its report, *Uncertainty* refers to those issues that have not been sufficiently studied to draw definitive conclusions. *Disagreement* refers to those issues for which published data, interpretations, and research findings and their consequences contradict or conflict with one another.

Ms. Langstaff went on to note that there are two new sections in the current draft that have been added since the last draft that was before the Advisory Committee. There is a new discussion of Science and Scientific Method, and a new section specifically on Strandings & Beaked Whales: Special Considerations. She went on to add that the report does not contain any specific recommendations, but that the Subcommittee did develop a list of research or information needs that flow directly and logically from the discussions of areas of uncertainty or disagreement. Whether and how this list might become part of the report has not yet been determined.

Finally, Ms. Langstaff described the process for external review that the Subcommittee's report has undergone. A previous draft was sent to four outside reviewers (Doug Wartzok, Randy Reeves, John Richardson and Jim Mead). Three of the reviewers were able to provide comments back to the Subcommittee (John Richardson was unable to do so within the available timeframe). Their overall response was positive. They indicated that the report was comprehensive and appropriate for the intended audience. They provided specific suggestions for revisions, both editorial and substantive. The Subcommittee met to address the comments of reviewers, and the draft before the Advisory Committee reflects their revised draft.

Following Ms. Langstaff's introduction to the Draft Report on Synthesis of Current Knowledge, Advisory Committee members agreed to take some time for individual interest-group caucuses before holding a full discussion on the draft. The caucuses then reported to the full Advisory Committee.

Environmental/Animal Welfare Caucus

In reporting on behalf of the environmental and animal welfare caucus, ***Mark Simmonds, Whale and Dolphin Conservation Society,*** emphasized that the key issue is how the document is used in the full report. If the report is to be retained in the main body of the Committee's report, it is too long and too technical. To correct this, he described a proposed 2-stage process for resolving this: 1) to identify an editor (external to the Committee) to undertake a re-casting of the document, and then 2) a cross caucus review with non-scientist participation to help ensure an accessible tone and level of technicality. In response to clarifying questions, Mr. Simmonds indicated that if the report were not to be included in the main body of the Committee Report, but was instead to be an appendix or stand-alone report, it would be more acceptable with its current level of technicality, though there remain some substantive issues that need further work. Finally, he noted that the new section on strandings raised considerable concern on the part of the environmental/animal welfare caucus, and that this section requires additional work regardless of the final disposition of the report.

Researchers Caucus

Dick Pittenger, Woods Hole Oceanographic Institution (retired), and ***Peter Worcester, Scripps Institution of Oceanography,*** reported on behalf of the researchers caucus, noting that the Subcommittee report represents a very useful effort that should be included in some manner in the Advisory Committee's final report. They expressed appreciation for the review process undertaken already by the Subcommittee, but suggested that that review was too fast and incomplete. They

supported the proposal for additional review, and suggested that it should be equivalent to any other scientific review process: 1) an outside lead editor should be selected and 2) he/she should select several outside reviewers who should review the science and 3) the editor should collect their comments and provide them to the Subcommittee; 4) the Subcommittee should address the comments through revisions to the document and then 5) send a newly revised draft back the full Advisory Committee. If the report goes through this kind of process, it could then be included in the body of the Advisory Committee's report.

Industry Caucus

Jim Ray, Oceanic Environmental Solutions, LLC, congratulated the Subcommittee for a good effort in being responsive to their charge. He indicated that the industry caucus is in favor of including the report somewhere in the Committee's report, but that it should not be significantly cut. He described a vision of the Full Report as including 1) a stand-alone Executive Summary; 2) the main body of the report that should not be "dumbed-down" and 3) other pieces or appendices as appropriate. ***Chip Gill, International Association of Geophysical Contractors***, emphasized that the Subcommittee's report should appear in the full body of the report and that the transparent and cross-caucus nature of the Subcommittee's work has resulted in a document that does not require significant changes.

State and Federal Agency Caucus

David Cottingham expressed the concerns of the agency caucus over the length of the Subcommittee report and the need to condense it in some way if it is to be part of the body of the Advisory Committee report. He noted three potential ways forward: 1) a shorter version in the body of the Full Report, 2) the full Subcommittee documents as a separate background document or appendix. Finally, he stressed that a very brief version needs to appear in the Executive Summary.

Individual Committee members made the following additional comments in an open discussion.

- The introduction to the Subcommittee report does not currently describe the Subcommittee's protocol for literature cited in the report. This was probably an oversight that simply needs to be remedied.
- In several sections of the report, there is a sentence under the "disagreement" sections that is repeated several times indicating that there is no disagreement. These sentences oversimplify the debate and should be deleted.
- The report is as short as it can be in order to do the job it was intended to do. If a shorter version is to be developed, it should be done outside of the Subcommittee that developed the current draft.
- The current draft seems to be a well-balanced document. Continued efforts to revise it are likely to undo the efforts of the Subcommittee to remove interest-based spin.
- A useful framework for the report would be a Risk Assessment methodology.
- While on first look the Subcommittee report may appear too long and detailed, it needs to be as long as it needs to be in order to be scientifically accurate. From a scientific standpoint, the thought of doing a 10-15 page summary version is terrifying.
- The report as it stands is hard to accept at all due to inaccuracies and omissions that make it indefensible. This is probably due to the fact that the Subcommittee did not include a balance

of interests in its make up (a single environmental NGO). In the section on fish in particular, the references are handled inconsistently.

- We need to clarify that this is not a synthesis of *scientific* knowledge, but of *current* knowledge. It is not just a science document. In a review process such has been suggested, the editor should be guided by the understanding of the need to be balanced. Let the document be as long as it needs to be to be complete and to reach consensus.
- There are specific problems in the text regarding how information is actually used. First of all, what counts as rigorous scientific correlations or associations? The bar seems to be set very high, particularly when you consider we are dealing with marine mammals and their environment. Secondly, this is an emerging issue, and new information is being revealed, reviewed and published as we speak. How do we consider new information? Is there a cut-off date for peer-reviewed published literature? What definition of "peer-reviewed" are we using (note that scientific correspondence (as in case of Jepson letter) in *Nature* is peer reviewed).
- Additional review should not be strictly scientific, but should have an emphasis on editorial improvements to make it more crisp, and reader-friendly. If the already proposed review process proceeds, one of the reviewers should be non-technical.
- The review process is not likely to shorten the document.
- This draft needs to be considered in the context of the overall Committee Report. We need to balance the importance of knowledge, science and research with the need to find ways to reduce the acoustic threats to marine mammals (the management and mitigation piece). If we have twice as many pages on the science and research as we do on management and mitigation, this implies a "wrong" relative emphasis. We need a balance in positioning and extent of text on these two parts of the equation in the final report.

Several Committee members stressed the need for more in-depth discussion and revision to the new section on "Strandings and Beaked Whales: Special Considerations".

Ms Langstaff summarized by noting that there is support for keeping the Subcommittee product in the final report in some form. There are several proposals for an additional review process that will require additional discussion and consensus. A process needs to be in place for Committee members to provide their specific substantive comments on the current draft, and there is general agreement that in submitting comments, Committee members should include proposal for specific language changes or additions, the rationale behind it, and references of supporting literature. A more focused effort to identify specific issues and concerns regarding the Strandings section is needed. The Subcommittee will meet an additional time to address Advisory Committee comments as well as comments from any review process that is agreed to.

Advisory Committee members broke into caucuses to further discuss and seek consensus on an acceptable review process. The resulting agreement is described below.

Outcome of Discussions Regarding Next Steps for "Chapter" on Synthesis of Current Knowledge

Agreed that Marine Mammal Commission will oversee a review process:

- Commission will select an editor who will in turn select three outside technical reviewers. Editor will review draft Synthesis report for accuracy and completeness, will review reviewer

and Advisory Committee comments on report, and will provide the comments to the Subcommittee on Synthesis of Current Knowledge .

- Reviewers will review draft report for accuracy and completeness, and submit comments to editor.
- Advisory Committee members will also submit their comments to the editor through Erin Vos and the facilitators, with proposed text and references, and rationale for including them (by May 16).
- Subcommittee on Synthesis (with an additional NGO representative) will meet with the editor to review comments and revise Synthesis report as needed .
- Editor to attend Plenary 6 to describe process used for synthesis report to Advisory Committee.

For Revising the Section on "Strandings and Beaked Whales: Special Considerations:"

- Committee members will provide proposed additional information, to include any proposed new or revised text, references, and rationale to Advisory Committee for consideration in advance of a conference call on the strandings section.
- A conference call open to all Advisory Committee members who desire to participate will be scheduled.
- Proposed revisions and comments on the strandings section as suggested in conference call will go to the Editor.
- Editor will forward comments and suggested revisions to the Synthesis Subcommittee as with other comments from review process.

Discussion of Status of and Next Steps for International Section

Time constraints did not allow for full Advisory Committee discussion of the draft section on International Issues. Members of the small group who have volunteered to work on this section indicated that they have been working new pieces of this section, and there is additional work to be done, including:

- Filling gaps where the section remains incomplete
- Knitting together the various pieces,
- Agreeing on the appropriate level of detail
- Identification and articulation of any recommendations regarding the international component(s) of the issue.

They did provide an updated draft to the Advisory Committee at the meeting (see Attachment B). In working to complete this section, the small group has asked the Marine Mammal Commission to assist them with additional research regarding international bodies that might be interested or responsible for working on this topic. In addition, the small group will continue to work together by conference calls and exchange of drafts. They indicated that Advisory Committee members are welcome to participate in their conference calls, and that they will have a revised draft for Advisory Committee review in advance of the next plenary meeting.

Proposal for National Research Program on Marine Mammals and Sound

Mike Purdy, Lamont-Doherty Earth Observatory, presented a proposal developed by the research caucus for a national research program to address information needs for the marine mammal and anthropogenic sound issues. Given the time constraints faced in this meeting, the Advisory Committee agreed to conduct a series of conference calls to continue discussing this proposal, as well as all of the elements of the proposed report chapter on research issues. ***Penny Dalton, Consortium for Oceanographic Research and Education***, and ***Nina Young, The Ocean Conservancy***, volunteered to create a first draft of the revised chapter.

Executive Summary

David Cottingham noted that he would convene a small group to work on drafting the Executive Summary for the Final Report.

Summary of Meeting Outcomes

Advisory Committee Product

- Agreed to attempt to produce a 10-15 page Executive Summary, and a longer full report
- Agreed on revised outline (see Attachment D)
- Agreed on Problem Statement (see Attachment E)
- Agreed to focus recommendations on what is needed to improve problems identified

Synthesis of Current Knowledge Report Chapter

Agreed that Marine Mammal Commission will oversee a review process:

- Commission will select an editor who will in turn select three outside technical reviewers. Editor will review draft Synthesis report for accuracy and completeness, will review reviewer and Advisory Committee comments on report, and will provide the comments to the Subcommittee on Synthesis of Current Knowledge.
- Reviewers will review draft report for accuracy and completeness, and submit comments to editor.
- Advisory Committee members will also submit their comments to the editor through Erin Vos and the facilitators, with proposed text and references, and rationale for including them (by May 16).
- Subcommittee on Synthesis (with an additional NGO representative) will meet with the editor to review comments and revise Synthesis report as needed.
- Editor to attend Plenary 6 to describe process used for synthesis report to Advisory Committee.

For Section on "Strandings and Beaked Whales: Special Considerations:"

- Committee members to provide proposed additional information, with proposed text, references, and rationale to Advisory Committee for consideration in advance of conference call.
- Conference call open to all Advisory Committee members who desire to participate.

- Proposed revisions and comments on the strandings section as suggested in conference call will go to the Editor.
- Editor forwards to Synthesis Subcommittee as with other comments from review process.

Management and Mitigation Report Chapter

- A redlined version of report, showing deletions and revisions recommended by cross-caucus small group, will be circulated to Advisory Committee on Management and Mitigation by 4-29-05.
- Subcommittee on Management and Mitigation will meet to review changes and create revised draft, for distribution to Advisory Committee.

Research Issues Report Chapter

- Conduct conference calls[18] for all interested Advisory Committee members to discuss the following components of Chapter.
  - Research Priorities (working from draft proposal from cross-caucus group on information needs and revision proposed by researchers, see Attachments F and G)
  - Funding issues and suggestions (including proposal presented by Mike Purdy, Attachment H, and perhaps ethics issues)
  - Permitting issues and recommendations
  - Animal welfare recommendations (working from revised Working Group draft distributed at end of meeting, Attachment I)
- Nina Young and Penny Dalton will work to develop a proposal for integrating the pieces into a revised chapter.
- Determine whether or how to approach updating the master list of recommendations to include management and mitigation recommendations from other sources.

International Issues Report Chapter

- Small group (Metcalf, Stone, Simmonds, and Vos) to work on a revised draft chapter building on document distributed at meeting (Attachment C).
- Conference call for Advisory Committee to discuss draft and provide feedback to small group.
- Draft chapter to Advisory Committee for review and discussion at July meeting.

Executive Summary

David Cottingham to convene small group to work by conference call on Executive Summary.

[18] The research chapter development effort may require multiple conference calls. One could be focused on the research priorities, another on the permitting recommendations, and another on the integration of the pieces.

ATTACHMENTS

A. **Attendance at the Fifth Plenary Meeting of the Advisory Committee on Acoustic Impacts on Marine Mammals**
B. Summary List of Issues from Caucuses
C. Expanded Strawman: International Efforts To Reduce Impacts Of Sound On Marine Mammals
D. Revised Outline of Advisory Committee Report
E. Consensus Problem Statement
F. Research Priorities Proposed by Cross-Caucus Group
G. Researcher Caucus Proposed Revised List of Research Priorities
H. Proposal for US National Interagency Research Program on Marine Mammals and Sound
I. Revised Draft Report of Animal Welfare /Ethics Working Group (Including Appendix ##)

ATTACHMENT A
23 September 2005 – FINAL PLENARY FIVE MEETING SUMMARY

Attendance at the Fifth Plenary Meeting of the Advisory Committee on Acoustic Impacts on Marine Mammals

Committee Members and Alternates (39)

Dan Allen	ChevronTexaco Corporation
Kenneth Balcomb, III	Center for Whale Research, Inc.
David Bernhart	National Marine Fisheries Service
Jack Caldwell	Consultant
Carole Carlson	International Fund for Animal Welfare
David Cottingham	Marine Mammal Commission
Penelope Dalton	Consortium for Oceanographic Research and Education
Sarah Dolman	Whale and Dolphin Conservation Society
Chip Gill	International Association of Geophysical Contractors
Marsha Green	The Ocean Mammal Institute
John Hildebrand	Scripps Inst. of Oceanography, Marine Mammal Commission
Michael Jasny	Natural Resources Defense Council
Darlene Ketten	Woods Hole Oceanographic Institution
Martin Kodis	U.S. Fish and Wildlife Service
Robert LaBelle	Minerals Management Service
Bill Lang	Minerals Management Service
Stephen Leathery	National Marine Fisheries Service
RAdm. Tim McGee	Office of the Chief of Naval Operations (N61)
Kathy Metcalf	Chamber of Shipping of America
Paul Nachtigall	Hawaii Institute of Marine Biology
RAdm. Dick Pittenger, USN (Ret.)	Woods Hole Oceanographic Institution
G. Michael Purdy	Lamont-Doherty Earth Observatory
James Ray	Oceanic Environmental Solutions, LLC
Michael Reeve	National Science Foundation
Joel Reynolds	Natural Resources Defense Council
Naomi Rose	Humane Society of the United States
Charles Schoennagel	Minerals Management Service
Alexander Shor	National Science Foundation
Mark Simmonds	Whale and Dolphin Conservation Society
V. Frank Stone	Office of the Chief of Naval Operations (N45)
Bruce Tackett	ExxonMobil Corporation
RAdm. Steven Tomaszeski	Office of the Chief of Naval Operations (N61)
Peter Tyack	Woods Hole Oceanographic Institution
Sara Wan	California Coastal Commission
Lindy Weilgart	Dalhousie University
Donna Wieting	National Marine Fisheries Service
Judy Wilson	Minerals Management Service
Peter Worcester	Scripps Institution of Oceanography
Nina Young	The Ocean Conservancy

ATTACHMENT A
23 September 2005 – FINAL PLENARY FIVE MEETING SUMMARY

Staff (3)

Alyssa Campbell	Marine Mammal Commission
Erin Vos	Marine Mammal Commission
Andrew Wright	Marine Mammal Commission

Facilitators (2)

Suzanne Orenstein	Independent Facilitator
Lee Langstaff	Independent Facilitator

Observers (58)

Kyle Baker	National Marine Fisheries Service
Linda Bauch	American Petroleum Institute
Joel Bell	U.S. Navy
Deborah Ben-David	National Oceanic and Atmospheric Administration
Ann Bowles	Hubb-Sea World Research Institute
Bonnie Bruce	U.S. House of Representatives Resource Committee
Chris Butler-Stroud	Whale and Dolphin Conservation Society
Zante Capuno	U.S. Coast Guard
Alice Crowe	American Petroleum Institute
Cynthia Decker	Office of the Chief of Naval Operations
Holly Fergusson	Suez Energy North America
Leslie Fillmore	SRS Technologies
Lennis Fludd	Dept. of Transportation, Maritime Administration
Amy Fraenkel	U.S. Senate Commerce Committee
Roger Gentry	National Marine Fisheries Service
Howie Godlstein	Lamont Doherty Earth Observatory
Mardi Hastings	Office of Naval Research
Lt. Kimberly Haun	Office of the Chief of Naval Operations
Mac Hawley	Hawley Family Foundation
Margaret Hayes	Dept. of State, Office of Ocean Affairs
Frank Herr	Office of Naval Research
Robert Hofman	
Ken Hollingshead	National Marine Fisheries Service
Sarah Jensen	Alaska Eskimo Whaling Commission
Jim Kendall	Minerals Management Service
Alex Kuli	Defense Environment Alert
Barbara Lashinger	Stanley Associates
Lisa Lierheimer	U.S. Fish and Wildlife Service
John Mayer	U.S. Navy
Tom McIntyre	American Society of Mammalogists
Rodger Melton	ExxonMobil Corporation
Justyna Nicinska	Office of the Chief of Naval Operations
Patrick Opay	National Marine Fisheries Service
Daniel Owen	Fenners Chambers
Michael Palmer	U.S. Navy

ATTACHMENT A
23 September 2005 – FINAL PLENARY FIVE MEETING SUMMARY

Chris Parsons	George Mason University
Linda Petitpas	Office of the Chief of Naval Operations (N45)
W. E. Rasmussen	ExxonMobil Corporation
Susan Roberts	National Research Council, Ocean Studies Board
William Rossiter	Cetacean Society International
Patricia Rossmaier	
Rebecca Rossmaier	
Jennifer Salerno	Booz Allen Hamilton
Whitley Saumweber	U.S. Senate Commerce Committee
Kerry Sawyer	SRS Technologies
Helene Scalliet	NOAA National Marine Sanctuaries
Bill Schmidt	National Park Service
Don Shaver	U.S. Navy (NAVSEA)
Shelagh Smith	Cornell Laboratory of Ornithology
Brandon Southall	National Marine Fisheries Service
Phil Thorson	SRS Technologies
Susan Tomiac	Animal Welfare Institute
Steve Warner	Institute for Defense Analyses
Doug Wartzok	Florida International University
Ben White	Animal Welfare Institute
Andrew Wigton	ExxonMobil Corporation
John Young	ExxonMobil Corporation
David Zinzer	Minerals Management Service

Summary List of Issues from Caucuses

Need for statement about why action is needed to address problem, including context for problem

Utility of and confidence in report of the Subcommittee on Synthesis of Current Knowledge

Information needed for understanding extent of problem, and how to get it
- Highest priority information needs
- Time required to significantly improve information base
- Research methods that expose marine mammals to sound
- Concerns about credibility of research funded by sound producers
- Data from analysis of strandings

Risk assessment process improvements
- Information
- Transparency

Permitting
- Resources for Agencies' permitting processes
- Identifying and agreeing on streamlining that meets goals of various interest groups, e.g. programmatic EIS, bundling of permits, *deminimus* option
- Debate about revising MMPA to address permitting issues

Mitigation
- Information about effectiveness and costs – how to obtain
- What to do given concerns about effectiveness
- Precaution component

International
- Global/transboundary nature of problem
- Mechanisms for international coordination on solutions
- Comparison of US and other countries re: management

Process for developing Executive Summary and highlighting "most important" recommendations

Expanded Strawman: INTERNATIONAL EFFORTS TO REDUCE IMPACTS OF SOUND ON MARINE MAMMALS

International Management Mechanisms

While individual nations may develop policies to address sound in the marine environment (particularly in coastal and continental shelf waters), neither marine mammals nor sound sources respect boundaries imposed by legal systems that must be used to effectively implement and enforce those requirements. Few marine mammal species have distributions restricted to the waters of the Exclusive Economic Zone of any one country. While the problem of potentially harmful anthropogenic sound in the ocean is international in scope, most of the management mechanisms are domestic or regional. There has been considerable debate and discussion about whether international fora should be identified or created to provide an international system to address management and mitigation of sound in the marine environment in a globally meaningful and effective manner.

I. Summary of Marine Mammal Commission International Workshop: Policy on Sound and Marine Mammals

An international policy workshop on sound and marine mammals was held 28-30 September 2004 in London, England, sponsored jointly by the U.S. Marine Mammal Commission and the U.K. Joint Nature Conservation Committee (JNCC). Over 100 participants from more than 20 countries attended. Because the 2003 Congressional mandate described above directed that the Commission's efforts to address acoustic impacts on marine mammals be international in scope, the Commission decided to attempt to investigate directly how the issue is (or is not) being addressed outside the United States. It hoped, in the process, to build relationships to improve international communication and cooperation. The 28 Advisory Committee members supported the idea of a Commission-sponsored international policy workshop and provided valuable advice in the early planning stages. The Commission and JNCC agreed in March 2004 to collaborate in drafting the agenda, identifying participants, convening the workshop, and producing a workshop report.

The workshop's goals were to (1) determine the range of existing efforts to manage, mitigate, and prevent impacts of human-generated sound on marine mammals outside the United States; (2) determine the extent to which legal and regulatory frameworks, other than those provided by U.S. domestic laws and regulations, address acoustic impacts on marine mammals; (3) identify cross-boundary or multilateral issues regarding the management and mitigation of acoustic impacts on marine mammals; and (4) identify innovative management strategies and policies that might be incorporated within national and international frameworks. Given that the intent was not to develop recommendations or reach consensus on issues, the focus was on establishing dialogue across international boundaries and on widening the perspectives and strengthening the knowledge base of workshop participants. The workshop conveners and participants made an effort to share information and improve understanding of the range of views on the various topics discussed.

[insert brief text describing key discussions at the workshop—see workshop report when available]

II. Examples of Domestic Practices in Other Countries

[JNCC Guidelines?]

[Australian Guidelines?]

[Brazilian Guidelines?]

[Spanish Guidelines for Canary Islands?]

[Other??]

III. Examples of International and Regional Conventions

Agreement on the Conservation of Cetaceans of the Black and Mediterranean Sea and Atlantic Contiguous Area (ACCOBAMS)

The ACCOBAMS Scientific Committee has identified various sources of anthropogenic sound as causes for concern and action. In 2003, the Committee issued its Recommendation 2.7 on Man Made Noise.[19] This document recommends, among other things, that, pending further research and guidelines on the deployment of sonar, "ACCOBAMS parties consult with any profession using such acoustic devices, including military activities, and urge that extreme caution be exercised in their use in the ACCOBAMS area, with the ideal being no further use until satisfactory guidelines are developed."[20]

At the Second Meeting of the Parties to ACCOBAMS in November 2004, the Parties passed Resolution 2.16 on the assessment and impact assessment of man-made noise. This resolution, among other things (1) urged that, within the ACCOBAMS area, the use of anthropogenic sound be avoided if appropriate in marine mammal habitat, and that any use of anthropogenic sound in or near areas believed to be the habitat of Cuvier's beaked whales be undertaken only with special caution and transparency; (2) urged the Parties to facilitate national and international research on various aspects of the issue; (3) urged the Parties to provide the ACCOBAMS Scientific Committee with public, national, or international protocols or guidelines for sonar use developed by military authorities in the context of addressing threats to cetaceans, along with the information upon which they are based; (4) urged the Parties to consult with parties conducting activities known to produce underwater sound with the potential to cause adverse effects on cetaceans, recommending that extreme caution be exercised in the ACCOBAMS area; and (5) encouraged the development of alternative technologies and requirements for the use of best available control technologies and other mitigation measures in order to reduce the impacts of anthropogenic sound in the ACCOBAMS area.

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[19] Report of the Second Meeting of the Scientific Committee to ACCOBAMS, Istanbul, 20-23 November 2003, Annex 34g, Recommendation 2.7 (2003).
[20] *Id.*

Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS)

ASCOBANS has begun to address undersea noise pollution in its *Conservation and Management Plan*, which is annexed to the Agreement. This Annex sets forth mandatory conservation measures to be applied to cetaceans, including "the prevention of . . . significant disturbance, especially of an acoustic nature."[21] At the Forth Meeting of the Parties to ASCOBANS in August 2003 the Parties passed Resolution Number 5 on Effects of Noise and of Vessels. Among other things, this resolution requests that Parties take a series of steps to reduce the impact of noise on cetaceans from seismic surveys, military activities, shipping vessels, acoustic harassment devices, and other acoustic disturbances.[22] The resolution requested that the Parties and Range States introduce guidelines on measures and procedures for seismic surveys to prevent significant disturbance of cetaceans. Parties and Range States were also invited to conduct research and report on approaches to reduce or eliminate adverse effects of military activities on small cetaceans before the ASCOBANS Advisory Committee meeting in 2005.

Convention on Biological Diversity (CBD)

The Preamble of the CBD notes that: "Where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat." Moreover, parties whose activities may pose grave or imminent danger or damage to biological diversity are required to notify potentially affected states, and must take action to prevent or minimize such damage (Art. 14(1)(d)).[23]

Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)

The OSPAR Convention is aimed at protecting the marine environment from human-made pollution, including energy, and several OSPAR documents have approached the problem of underwater sound as a form of pollution having adverse effects on the marine environment. "Noise disturbance" is listed among the potentially dangerous effects of human activities that may need to be regulated within or in the vicinity of marine protected areas (MPAs) to achieve the objectives of MPA designation, and, further, is recognized by the OSPAR Commission as among the potentially harmful effects of human activities posing threats to several species of whale.[24] Further, at its most recent a meeting in 2004 the OSPAR Commission recognized the need to further assess pollution from undersea noise "raised by offshore activities" and directed its Secretariat to prepare a report to its Offshore Industry Committee on this topic.[25]

European Community Habitats Directive

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[21] ASCOBANS, Annex, para. 1(d).
[22] Fourth Meeting of Parties to ASCOBANS, Res. 5 *Effects of Noise and of Vessels* (2003).
[23] CBD, (Art. 14(1)(d))
[24] See OSPAR Commission, 2003; OSPAR Commission, Case Reports for the Initial List of Threatened and/or Declining Species and Habitats in the OSPAR Maritime Area at 91 (YEAR?).
[25] OSPAR Commission, Draft Summary Record, OSPAR 2004 (OSPAR 04/23/1-E) Annex 20, 2004/05 Product 17. (YEAR?)

The European Community (E.C., sometimes referred to as the European Union or E.U.) can adopt legislation in the form of legally-binding Directives, which are implemented through national laws, regulations, or administrative provisions that refer to the Directive in question. Member States often implement Directives by simply transposing the language of a Directive into national law.[26] The E.C. Habitats Directive was adopted in 1992, and its provisions had to be implemented through existing Member States' national legislation by 1994.[27] Its provisions also apply to those Member States who subsequently joined the EU.

The Habitats Directive is a nature conservation instrument, with provisions for both habitat- and species-based protection.[28] The habitat protection provisions focus on the establishment and protection of a E.C.-wide network of sites known as *Natura 2000*, comprising Special Areas of Conservation (SACs).[29] The selection of SACs for *Natura 2000* is a task for the E.C. Member States in conjunction with the European Commission. SACs are selected for the habitats and species listed in Annexes I & II of the Directive. Marine mammals species listed in Annex II include the gray seal, monk seal, harbor seal, bottlenose dolphin, and harbor porpoise. The protection regime for SACs is rigorous, though it includes some scope for activities that "must … be carried out for imperative reasons of overriding public interest."[30]

The species protection provisions of the Directive require the E.C. Member States to "take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV(a) in their natural range…"[31] Annex IV(a) includes all species of cetaceans, as well as some species of otters and pinnipeds. The system of strict protection must prohibit, among other things, "all forms of deliberate capture or killing of… these species in the wild…" and "deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration…"[32][33]

Article 12 of the Directive further dictates that "Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV(a). In the light of the information gathered, Member States shall take further research or conservation

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[26] If a Member State fails to properly implement any provision of a Directive by the prescribed deadline, that provision may still be effective through the European Court of Justice's doctrine of "direct effect." This doctrine allows an individual to invoke a non-transposed provision against the Member State if certain conditions are met (*e.g.*, the provision in question must be unconditional and sufficiently precise). The European Commission must ensure that proper implementation is achieved, and has the power to start infringement proceedings in the European Court of Justice in cases (1) when transposition did not occur within strict time limits, (2) where transposition to national legislation did not accurately reflect the provisions of the Directive, or (3) where Member States are failing in their obligations under a Directive. Where there is any conflict with national legislation, the E.U. Directive takes precedence.

[27] E.C. Habitats Directive

[28] The E.C. Habitats Directive has both a terrestrial and marine application. Its marine application includes the internal waters and territorial sea of the coastal E.C. Member States; many such States have now also accepted that the Directive applies to their exclusive economic zones (or equivalent).

[29] The *Natura 2000* network also includes Special Protection Areas under the EC Birds Directive.

[30] E.C. Habitats Directive

[31] E.C. Habitats Directive

[32] Derogations from these duties are permitted in limited circumstances.

[33] E.C. Habitats Directive Article 12 §1

measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned."[34]

In October 2004 the European Parliament passed a resolution that, among other things, (1) called for the European Union and its Member States to adopt a moratorium on the deployment of high-intensity active naval sonars until a global assessment of their cumulative environmental impact has been completed; (2) called on the Member States to immediately restrict the use of high-intensity active naval sonars in waters falling under their jurisdiction; (3) called on the Member States to monitor and investigate (in a transparent manner) mass strandings of marine mammals in E.U. waters that have been associated with intense anthropogenic sound and to communicate the findings to the European Commission; (4) called for the European Commission and the Member States to set up a multinational task force to develop international agreements regulating sound levels in the world's oceans, with the goal of limiting the adverse impact of anthropogenic sound on marine mammals and fish. While European Parliament resolutions are non-binding, they serve to raise awareness in the European Community and bring issues to the European Commission agenda.

International Convention on the Prevention of Pollution from Ships (MARPOL)
Pollution from energy sources (and therefore sound) is not included within MARPOL's scope, which defines pollution to include only harmful substances. Limitations on undersea sound from shipping therefore cannot be managed by IMO through MARPOL unless a modification to the convention is adopted. To use MARPOL to regulate anthropogenic sound, it would be necessary to amend Article 1(1) to include sound.

International Convention on the Regulation of Whaling (ICRW)
Much controversy surrounds the competence of the International Whaling Commission (IWC) to enact measures for the conservation of any species outside the context of commercial whaling. However, the IWC has held two fora on the issue of ocean noise, and the need for its regulation and further study. For instance, Resolution 1998-6 of the International Whaling Commission (IWC) identified "anthropogenic noise" as a priority topic for investigation within its Scientific Committee, and the IWC Scientific Committee, in its report to the 56th meeting of the IWC (July 2004),[35] concluded that there is now compelling evidence implicating military sonar as a direct impact on whales, in particular on beaked whales. The Committee also agreed that evidence of increased sounds from other sources, including ships and seismic activities, was cause for serious concern.

At the 2003 meeting of the Scientific Committee of the International Whaling Commission, the Standing Working Group on Environmental Concerns (SWG) noted the importance of the emergent threat of anthropogenic sound to cetaceans and other elements of marine ecosystems. In response, the SWG organized a mini-symposium on acoustics, held during SWG sessions prior to the International Whaling Commission meeting in July 2004. The conclusions and recommendations from the mini-symposium were presented to the Scientific Committee, which in turn drafted a report with recommendations for the International Whaling Commission (IWC). Both the Scientific Committee and the IWC agreed that there is compelling evidence implicating military sonar as having a direct impact

[34] E.C. Habitats Directive Article 12 §4
[35] IWC Scientific Committee, 2004

on beaked whales, in particular. They further agreed that there is evidence of increased sounds from other sources, including ships and seismic activities, which is cause for serious concern. On the general topic of anthropogenic sound impacts on cetaceans, the IWC adopted the Scientific Committee's recommendations for (1) the integration and coordination of international research projects to study and describe acoustic ecologies; (2) the inclusion of anthropogenic noise assessments and noise exposure standards within the framework of national and international ocean conservation plans (*e.g.*; consideration during designation of critical habitats, marine protected areas and ocean zoning); and (3) support for multinational programmes to monitor ocean noise and the development of underwater noise budgets at various scales. The IWC also endorsed commendations relating to mitigation and monitoring protocols (among other things), commending them to member governments, and requesting that they be transmitted to representatives of geophysical exploration and petroleum industries, and various committees and agencies, including the U.S. Marine Mammal Commission and the U.S. National Marine Fisheries Service.

International Convention for the Safety of Life at Sea (SOLAS)
This convention and some other regional and international agreements do not necessarily fall into one of the above categories, but may be relevant to addressing anthropogenic sound in the oceans, and should therefore could be explored as potential models or instruments for managing and mitigating anthropogenic sound in the world's oceans, especially for commercial shipping.

United Nations Convention on the Law of the Sea (UNCLOS)
UNCLOS establishes a globally recognized regime dealing with all matters relating to the uses of the oceans and seas and their resources. UNCLOS assigns the fundamental obligation and responsibility for protecting and preserving the marine environment to States, and requires them to adopt and enforce national laws and international standards to prevent, reduce and control ocean pollution from any source. The convention defines "pollution" to include harmful energy, and thus could be interpreted to encompass sound pollution within its mandates.

IV. Examples of Multilateral Bodies

Convention on Biological Diversity (CBD) Secretariat

Convention on Migratory Species (CMS) Secretariat

International Association of Geophysical Contractors (IAGC)

International Maritime Organization (IMO)

International Whaling Commission (IWC)

North Atlantic Treaty Organization (NATO)

United Nations Environment Programme (UNEP)

United Nations Educational, Scientific and Cultural Organization Intergovernmental Oceanographic Commission (UNESCO- IOC)

V. Fostering International Dialogue

International Collaboration

There is considerable research into the effects of underwater sound on marine fauna and ecology ongoing outside US jurisdiction. Various countries are currently developing management responses to sound-related issues. It is also possible that the underwater sounds produced by the activities of other nations may have an effect on species, habitats and ecosystems of interest to the US. These considerations speak to the need for international collaboration including information exchange and skill-sharing on marine acoustic issues. New data will emerge in this field with potential significance to mitigation in the next few years both from within the US sphere and elsewhere.

In order to ensure that the potential problems relating to underwater sound are being addressed in the best-informed manner, some form of ongoing international dialogue should be sought, drawing on the expertise of all those involved in research and/or management in this topic area. No such formal mechanism currently exists but consideration should be given to establishing a regular international forum perhaps by facilitating the consideration of this matter by an existing international meeting cycle with an appropriate focus.

The Marine Mammal Commission review of marine acoustic concerns is the only large-scale ongoing stakeholder dialogue on this theme worldwide and its discussions, conclusions and other outputs are of interest to the concerned global community. Therefore, part of the facilitation of an ongoing international dialogue should include a commitment to, and a formal strategy for, dissemination of outputs to non-US bodies for their information and to facilitate work on this theme.

VI. Recommendations Regarding International Efforts to Reduce Impacts of Sound on Marine Mammals

- [international mechanism for collection and sharing of scientific information among governments]
- [international mechanism for collection and sharing of mitigation technologies and information on mitigation tools and effectiveness]
- [development of guidelines for sound producers at an international level]

Revised Outline for Final Report

April 21, 2005

I. Executive Summary
Include Statement of Problem

II. Introduction to report

III. State of Knowledge (what we know and don't know - based on Synthesis Report)

- Identify acoustic threats
- Strandings

IV. Management and Mitigation

(Menu of M&M Tools/solutions with discussion and critique)

- What doing now
- What could you do
- What needs to be developed
- Recommendations on M&M

V. Research Issues

- Research Needs and Priorities
- Permitting (highlight need for resources for permit reviews)
- Funding diversity
- Animal welfare ethics issues for directed research on MMs in wild

VI. International

- International scientific efforts
- What others are doing re mgt./mitigation (incl. other Navies)
- Recommendation re ongoing mechanism/forum(s) to facilitate discussion of marine mammal issues (including noise)

ATTACHMENT E
23 September 2005 – FINAL PLENARY FIVE MEETING SUMMARY

STATEMENT OF THE PROBLEM

(4.20.05 CONSENSUS draft)

Marine mammals have evolved over millions of years and rely on sound for vital life functions.

Anthropogenic sound in the oceans has increased since the start of the industrial revolution, and increases in ambient noise levels, as well as individual sound sources, may cause adverse effects the extent and type of which are not well understood. These sound sources include, among others, vessels, sonar operations, seismic surveys, coastal construction, acoustic harassment devices.

After a series of highly-publicized strandings of cetaceans coincident with exposure to mid-frequency sonar, public concern has increased about the effects of anthropogenic sound. This emerging concern has been acknowledged by a variety of domestic and international fora.

Peer-reviewed scientific literature indicates that marine mammals are affected by exposure to a range of anthropogenic sound in ways varying from inconsequential to harmful, or even lethal. However there are significant gaps in information available to understand and manage these effects.

This is particularly the case because marine mammals are extremely difficult to study, and the marine environment is extraordinarily complex and dynamic.

Federal agencies, researchers, and sound-producing entities are grappling with problems in permitting ocean activities while protecting marine mammals. Management agencies must make decisions about how to manage these effects in the face of substantial uncertainties. While research and substantial resources are needed to refine management and better understand the effects of anthropogenic sound, there is a need to proceed expeditiously with sensible mitigation measures to address potential adverse effects without waiting for complete scientific certainty.

The Advisory Committee recognizes that anthropogenic sound is one of many threats facing marine mammals, such as fisheries bycatch, habitat degradation, ocean pollution, whaling, vessel strikes, and others. The effects of these threats may be cumulative. Consistent with the direction from Congress, we have focused only on effects of anthropogenic sound and not on other threats to marine mammals.

ATTACHMENT F
23 September 2005 – FINAL PLENARY FIVE MEETING SUMMARY

INFORMATION NEEDS

(4.20.05 cross-caucus group discussion-NOT A CONSENSUS PRODUCT)
(Bernhardt, Caldwell, Carlson, Green, Hildebrand, Lang, Melton, Nachtigall, Southall, Stone, Tyack, Vos, Weilgart)

TASKS

1) Master list of research needs/recommendations
   -base on existing drafts (NRC+, M&M, and Subcommittee)
   -draft mitigation/management related recs from previous reports (e.g. NRCs, etc)

2) Summary list of top research priorities

- NOTE: need process recommendations to facilitate research
  -short paragraph on how to best fund needed research? Base on research issues sections?
  "Scientific research depends on…."

Common categories of information needs:

F. Sound Sources and Sound Field Characterization
G. Baseline Marine Mammal Information
H. Effects of Anthropogenic Sound on Marine Mammals
I. Mitigation
J. Development of Mitigation and Research Tools

A. Sound Sources and Sound Field Characterization

- As part of standardized ocean observation networks, measure a full range of acoustic parameters in order to better understand short- and long-term trends in ambient ocean noise levels on global, regional, and local scales, and allow for the development of models of ambient noise.[36]

B. Baseline Marine Mammal Information

- Conduct research on the status, abundance, stock structure, life histories, and distribution of marine mammals, developing standardized methods and identifying important geographic and seasonal trends. [37]
- Develop, test, and validate models to characterize and predict marine mammal habitat use (*e.g.*, cold spots and hot spots).[38]
- Conduct research and develop, test, and validate models to better understand the functions of marine mammal behavior, including communication.[39]

[36] Recommendations from Cox *et al.* in review, IWC/SC 2004, Miller *et al.* 2005, NRC 2003, NMFS in prep., Simmonds *et al.* 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[37] Recommendations from Cox *et al.* in review, Evans and Miller 2004, IWC/SC 2004, NRC 2003, Simmonds *et al.* 2003, and U.S. Navy 2005a support this.
[38] Recommendations from Cox *et al.* in review, NRC 2003, and U.S. Navy 2005a support this.
[39] Recommendations from Cox *et al.* in review, NMFS in prep., NRC 1994, and NRC 2000 support this.

- Conduct research and develop, test, and validate models to better understand marine mammal auditory systems and hearing capabilities, developing and refining new techniques, including auditory brainstem response (ABR) methods, as appropriate.[40]

C. Effects of Anthropogenic Sound on Marine Mammals

- Conduct long- and short-term research and monitoring, and develop, test, and validate models to better understand and predict the occurrence and consequences of marine mammal behavioral responses to anthropogenic sound exposure (including tolerance, habituation, sensitization, disturbance, and habitat avoidance or abandonment), as well as the relationship of these responses to physiological effects, with particular attention to sound exposures in important marine mammal habitat.[41]
- Conduct research and develop, test, and validate models to better understand and predict the onset and consequences of temporary and permanent threshold shifts and masking, as well as the types of sound exposure that cause them and their relationship to other auditory and behavioral effects.[42][43]
- Conduct research to better understand and predict the occurrence and consequences of physiological effects from anthropogenic sound exposure, as well as the relationship of these effects to auditory and behavioral effects, including directed and opportunistic examinations of marine mammal anatomy, physiology, pathology, and strandings.[44][45]
- Conduct retrospective analyses of stranding events, including comparisons of pathologies, environmental variables, and anthropogenic sound sources present.[46]
- Conduct research and develop, test, and validate models to characterize population-level effects and biological significance of anthropogenic sound exposure.[47]
- [Conduct CEEs]

D. Mitigation

- Research the feasibility, appropriateness, practicality, and effectiveness of mitigation tools in various contexts.
- Investigate modification of sound sources to minimize adverse effects.

E. Development of Mitigation and Research Tools

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[40] Recommendations from Cox *et al.* in review, Evans and Miller 2004, Jasny and Reynolds 1999, NMFS in prep., NRC 1994, NRC 2000, Simmonds *et al.* 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[41] Recommendations from Cox *et al.* in review, Evans and Miller 2004, IWC/SC 2004, Miller *et al.* 2005, NMFS in prep., NRC 1994, NRC 2000, NRC 2003, Simmonds *et al.* 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[42] Recommendations from NRC 2000, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[43] Recommendations from Miller *et al.* 2005, NMFS in prep., NRC 2000, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[44] Recommendations from Cox *et al.* in review, Evans and Miller 2004, Southall *et al.* in prep., and U.S. Navy 2005a, support this.
[45] Recommendations from Cox *et al.* in review support this.
[46] Recommendations from Cox *et al.* in review and IWC/SC 2004 support this.
[47] Recommendations from Cox *et al.* in review, NRDC 1999, Simmonds *et al.* 2003, and Southall *et al.* in prep. support this.

- Develop alternative sound source technologies.
- Develop tracking and tagging technologies, ABR techniques, and controlled exposure experiments (CEEs) as appropriate to investigate effects of anthropogenic sound.[48]

Develop methods to understand the effects of anthropogenic sound on marine organisms and ecosystems, as well as cumulative and synergistic effects of multiple exposures to anthropogenic sound and exposures to other threats.[495051]

[48] Recommendations from Cox *et al.* in review, Evans and Miller 2004, Miller *et al.* 2005, NMFS in prep., NRC 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[49] Recommendations from Jasny and Reynolds 1999, NRC 1994, NRC 2000, NRC 2003, Simmonds *et al.* 2003, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[50] Recommendations from NRC 1994, NRC 2000, Southall *et al.* in prep., and U.S. Navy 2005a support this.
[51] Recommendations from IWC/SC 2004, Jasny and Reynolds 1999, Southall *et al.* in prep., Simmonds *et al.* 2003 and U.S. Navy 2005a support this.

Proposed Revisions to Research Priorities – Developed by Research Caucus 21 April 2005

Sound Field Characterization

- Develop a global passive acoustic monitoring network, coordinated with existing and planned ocean observing systems, to understand spatial and temporal variability in sound sources and ocean ambient noise

Baseline Marine Mammal Information

- Improve knowledge of marine mammal abundance, stock structure, life history, seasonal distribution, and behavior, including acoustic communication
- Develop, test, and validate new techniques and models to better understand marine mammal hearing systems

Effects of Anthropogenic Sound on Marine Mammals

- Conduct long- and short-term research and monitoring, utilizing proper experimental controls, to allow sensitive measures of behavioral and physiological responses to anthropogenic sound
- Conduct research to better understand and predict the onset and consequences of auditory masking and hearing loss, as well as their relation to behavioral or other physiological effects
- Improve capabilities to investigate, using adequate scientific rigor, the possible role of acoustic exposure in marine mammal stranding events, including comparisons of anthropogenic, environmental, and biological variables

Mitigation

- Quantify the feasibility, effectiveness, and practicality of existing and proposed mitigation measures
- Investigate modifying sound sources to minimize adverse effects on marine mammals

Development of Mitigation and Research Tools

- Develop/improve standardized data formats for marine mammal abundance and distribution and develop a database for management and public access
- Develop alternative sound source technologies, as appropriate and practical
- Improve and implement tracking and tagging technologies, auditory brainstem response (ABR), and controlled exposure experiments (CEE), as appropriate and practical
- Develop capabilities to assess the effects of sound on marine ecosystems, as well as cumulative and synergistic effects of multiple exposures and interactions with non-acoustic stressors

US National Interagency Research Program
on Marine Mammals and Sound

Proposed to Advisory Committee on 4-21-05

A research program should be established to support extramural research to understand interactions between marine mammals and all sources of sound in the world's coastal and global oceans. This should be an interagency program with a co-ordination mechanism established to allow the participating Federal agencies to make optimal decisions with regard to disbursement of funding. In the first place this should be established as a US national program but there would be an expectation that it would be expanded to be an international activity in the near future.

A national commitment should be made to support this program for ten years, at which time a thorough review of accomplishments would be made. The total program should be grown to reach ~$25M per year over a 3-4 year period.

All grants made under this program would be competitively selected using established peer review procedures. Each year a Program Announcement will be published defining the priorities for the program. The content of this program announcement would be agreed to by the agency program managers, but would be based upon priorities determined by a community-based national steering committee. This steering committee will be populated by representatives of all interest groups, but will be charged with giving recommendations on research program priorities only. The steering committee will be staffed by a national program office that will aid with public outreach and co-ordination.

Participating agencies in this program should include NSF, Navy, NOAA, MMS, FWS……..New appropriations to these agencies will be needed to support this activity.

Initiation of this activity will be achieved by the calling of a national workshop that will be charged with taking the research recommendations from the MMC report and converting them to an implementation plan, and with the establishment of the community-based steering committee that will be charged as the primary source of advice for the program.

Research Issues Section

III. Animal Welfare Ethics Considerations

Ethical and Animal Welfare Aspects of Directed Acoustic Research on Marine Mammals

The Advisory Committee formed a Working Group on Animal Welfare Ethics to address ethical considerations and principles in the context of directed marine mammal research in the wild that exposes animals to sound[52]. The group provided an overview and synthesis of guiding ethical principles for developing and executing controlled exposure experiments (CEEs) and auditory brainstem response (ABR) experiments[53].

The Role of CEEs and ABR Experiments in Research for the Purposes of Management

Our knowledge of marine mammal populations is generally so poor that we may not be able to detect a decline until it is too late,[i] and it may be impossible to identify the causes of the decline. This suggests the need for shorter-term studies on the responses of individual animals to risks such as anthropogenic sound. CEEs involve controlled doses of an acoustic stimulus applied to focal animals for the purposes of assessing behavioral and physiological responses. They can play an important role in the management of acoustic impacts on marine mammals, because they improve scientists' and managers' understanding of disturbance and other responses to sound exposure. In the management context, the conservation and/or animal welfare benefits of providing this information should clearly outweigh any potential harm to the individuals being exposed to sound if such experiments are to be pursued. CEEs can comprise one component of a larger research and management program, with the most effective mix of research approaches depending on the problems or questions being addressed.

Recently, CEEs were unanimously recommended as the top research priority for investigating the role of acoustic exposure in beaked whale strandings by participants at the Marine Mammal Commission's April 2004 Beaked Whale Technical Workshop.[ii] CEEs raise animal welfare concerns because they involve intentional exposure of marine mammals to sound, and the exposure thresholds that may cause pain or stress are not well understood or agreed upon.

CEEs cannot investigate injury or hearing damage. The lack of an obvious or measurable response does not necessarily mean that there is no physiological impact and chronic pathologies that lead to potentially lethal impacts may be undetectable and therefore underestimated. The

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[52] Conservation organizations represented on the Advisory Committee have contributed to this effort to define ethical principles and guidelines for CEEs and ABR, not as a blanket endorsement, but in an effort to ensure that CEEs and ABR experiments that occur are as protective as possible.

[53] This document addresses only research conducted in the wild, considering that the preponderance of species of concern are virtually impossible to observe in a captive situation, and ethical protocols and standards already exist for the treatment of captive animals subject to controlled experiments.

mechanism that leads to the onset of physical damage is under investigation and may not be fully understood for some time.

Acute and chronic behavioural responses have been observed in animals which have been approached and tagged. Consequently, with the introduction of directed sound, welfare issues associated with these experiments include the distress caused to individuals and energetic cost associated with the experiment, as well as indirect impacts on con-specifics. More generally, issues surround the limits of our understanding of the species biology and physiology

Auditory Evoked Potential Hearing Measures in Stranding and Rehabilitation Situations

There is a need to know more about the hearing of marine mammals in general, but urgency is increased because of concerns about auditory damage due to exposure to anthropogenic sound. One way that has been recently used to rapidly test hearing is to measure the auditory brainstem response (ABR) of dolphins or whales by passively measuring brainwave patterns from the skin surface. These tests were developed in captive facilities, but there is increasing interest in testing live stranded wild animals. While this technique provides an obvious value for the determination of hearing abilities of stranded animals and may also expand the knowledge base to include the hearing values of a variety of species that may likely not be kept in captive situations, the use of a new technique calls for ethical guidelines.

ABR can be used in many situations. It is routinely used with human infants and poses very little additional risk to the test subjects. This ethical discussion is limited to the situation of measuring ABRs on live stranded or beached wild marine mammals or stranded and beached marine mammals that have been removed to rehabilitation facilities.

There are many considerations to take into account when dealing with stranded animals. Researchers must recognize that research will not be the primary priority when dealing with stranded animals in a stranding situation. Those responsible for the animal's care will necessarily be in charge of the animal. ABR audiometry provides a diagnostic tool for the veterinarian.

All welfare issues must be balanced against the risks of managing impacts from other activities, when we do not have a full understanding of the risk factors involved. Regulation in the absence of critical research may not prevent potentially lethal impacts to individuals, or declines in wild populations.

Information on injury and behavioral disruption is needed for permitting and authorizing activities under the MMPA. Identifying sound exposure thresholds above which injury [or harassment] may occur must involve some extrapolation from experimental techniques. Behavior is best studied in ecologically valid settings in the wild, while most studies defining risks of injury or hearing damage are best suited for laboratory settings. The more realistic and intense the received levels of sound, in testing for potential impacts, the more serious the welfare and conservation concerns for the marine mammals that are subjects of the experiment.

Relevant U.S. Regulations Pertaining to Animal Care in Directed Research

In the U.S., both the Health Research Extension Act and the Animal Welfare Act require the establishment of animal care and use programs and guidelines for acceptable animal care in research. Most funding agencies and research institutions require compliance with all applicable laws for animal welfare and conservation, including the establishment of an Institutional Animal Care and Use Committee (IACUC).[54] In addition to this institutional oversight, research on marine mammals must be permitted under the Marine Mammal Protection Act by NMFS or USFWS. Most scientific journals require authors to state that their research follows ethical principles. However, even when CEEs and ABR tests are permitted and authorized, they have been legally challenged on animal welfare ethics and other grounds. Thus the Advisory Committee sought to develop guidelines for agreement on how CEEs and ABR testing could be designed to address the concerns raised by these challenges.

Ethical Principles for CEEs, and ABR Experiments, [55]

Guiding Ethical Principles for CEEs

To minimize risks to marine mammals that are the subjects of CEEs, the following suggested guiding principles should be incorporated into the design and implementation of CEEs used to inform management of acoustic impacts:

1) Experiments need to be designed to test hypotheses about specific responses of concern after initial research focuses the research questions (*e.g.*, disruption of foraging behavior) for particular sources and marine mammals. A well-designed experiment can test for a specific dose-response relationship, but cannot rule out all potential effects. In general, the lack of a measurable response to an acoustic stimulus cannot be used to infer that a particular exposure is "safe" with respect to any and all conceivable risks.

2) Include "end-points" for research that define the upper limit of exposure of current management interest and also define where the uncertainty about harms are too great to continue with one or more aspects of a research project or management activity. End-points can also define the lower limit of management interest where the expectation of response is so low (assuming control data exist) that the costs to conduct experiments are difficult to justify. Identifiable end-points will vary between species and it will be very hard to determine these threshold levels in advance.

3) No animal should ever be intentionally exposed to levels in the wild where injury is likely or expected. This requires extrapolation for species whose thresholds for

[54] IACUCs oversee research institutions' animal programs, facilities and procedures to insure adherence to ethical principles for animal handling and treatment.
[55]Please see Appendix x for more detailed information about ethical principles for research on vertebrate animals, procedures for applied CEEs; a specific discussion of ethical issues for CEEs to beaked whales.

injury are unknown. Also, even where sound exposure is limited to levels not expected to cause injury, it is possible that behavioral reactions might secondarily pose a risk of injury. Where such reactions are known, such as seals stampeding when they hear a sound, extra care must be taken to avoid the dangerous behavioral reaction.

4) It is preferable that CEEs comprise one component of a larger research and management program to minimize risk to the animals.

5) Vulnerability of an individual is a combination of its sensitivity and exposure, while the threat to the population is additionally a function of its conservation status. For some endangered species or populations, the risk of the experiment may be of concern and the use of a proxy species must be considered.

6) CEEs may ensonify a large area and therefore expose non-target animals to elevated sound levels. In this situation, it is important to monitor effectively for target and non-target animals and to minimize the risks associated with exposure.

7) It is important to consider the appropriate time scale when planning CEEs. Demonstration of causation between stimulus and response will usually be simpler and quicker with smaller scale CEEs. When the policy issues focus at larger scales, and there are questions about extrapolating the short-term results, a combination of small scale and larger scale CEEs may be needed.

8) Researchers undertaking similar CEEs should coordinate their activities to avoid unnecessary duplication of experiments.

9) Research that is more likely to yield conclusive results with similar or less effort should be preferred in situations where the risk of harm to the animals is similar.

Guiding Ethical Principles for ABR Experiments in Stranding and Rehabilitation Situations

The overriding consideration for dealing with stranded and beached marine mammals is the welfare of the animals. The primary goal in dealing with stranded animals is to assess their condition, determine whether or not they are healthy, and if they are healthy to return them to the wild. If ABR tests of animals that strand and beach are going to be conducted, all concerned, including the scientists, must agree that the primary goal for dealing with any stranded marine mammal is the proper care and welfare of the animal and that these experiments should in no way compromise that care.

The following suggested guiding principles should be incorporated into the design and implementation of ABR experiments used to inform management of acoustic impacts:

1. Researchers have an obligation to do everything practicable to assist in the care of the animal.

2. Given that the animal's welfare and care is the number one priority, researchers must work closely with the attending veterinarian.

3. No releasable animals should be moved into a rehabilitation facility for the sole purpose of taking ABR measurements.

4. The first priority for stranded animals is release if they are judged fit. The second may be to take them temporarily to a rehabilitation facility until they are fit for release; the third (when an animal is obviously in need of longer term care) is to house them in a rehabilitation facility until they are judged fit and then released with proper follow-up, and finally to be properly cared for within a holding facility. Research should not significantly interfere with or delay this process.

5. For ABR tests, the goal is to cover a very broad range of frequencies, with amplitudes starting low and ramping up. Experienced/trained researchers using the latest and most up to date equipment would increase the likelihood that highest quality data will be obtained.

6. Those conducting research should be highly trained and proficient prior to attempting ABR testing on a beached or stranded animal.

7. Should the animal show obvious increased signs of distress due to sound presentation, tests should be halted.

8. Routine testing of hearing for live stranded animals would help provide control data for evaluating whether known sound exposures affect the hearing of live stranded animals. Hearing tests should be used as diagnostic tests by stranding-response professionals to determine, if possible, whether the animal has been over-exposed to sound and what is the current state of the animal's auditory system. Assessment of the animal's auditory system may be useful in deciding whether to immediately attempt release or rehabilitate the animal. If animals are stranded following intensive sound exposure, auditory evoked potential (AEP) hearing tests should be used to measure the effects of sound exposure whenever feasible. However, AEP testing of animals with suspected impacts may involve some additional ethical considerations.

9. Researchers must recognize that, when dealing with a new species, the data may represent the norm for that species or they may represent a damaged or otherwise atypical animal. The difference between those two cases may only become evident with repeated opportunities to measure the hearing of that species.

APPENDIX ##: Additional Issues in Ethical and Animal Welfare Aspects of Directed Acoustic Research on Marine Mammals

General Principles for Research on Vertebrate Animals

Most professional societies of scientists conducting research on animals have adopted ethical principles for the treatment of animal subjects in experiments.[56] In the U.S., both the Health Research Extension Act and the Animal Welfare Act require the establishment of animal care and use programs and guidelines for acceptable animal care in research. Most funding agencies and research institutions require compliance with all applicable laws for animal welfare and conservation, including the establishment of an Institutional Animal Care and Use Committee (IACUC). IACUCs oversee research institutions' animal programs, facilities and procedures to insure adherence to ethical principles for animal handling and treatment. In addition to this institutional oversight, research on marine mammals must be permitted under the Marine Mammal Protection Act by NMFS or USFWS. Most scientific journals require authors to state that their research follows ethical principles. Therefore, research is already regulated or reviewed for animal welfare ethics concerns in various ways. Here, we list some of the ethical principles used in these standards.

Humane treatment of vertebrate animals used in research requires researchers to:

A. Comply with all applicable federal, state, and local laws and regulations.

B. Minimize potential for adverse impact to subjects to the fullest extent possible. Adverse impacts could also include effects on members of the species other than the individual subject (*e.g.*, mother-calf separation) and effects on other species, including disruption to ecological relationships.

C. Minimize mental, physical, and social stress to subject animals. However, measuring stress in marine mammals is particularly difficult and in its infancy – it is not clear how cetaceans physically exhibit symptoms of distress, in terms of behavioral responses or blood parameters (getting baseline data for their blood chemistry parameters is fraught with difficulties, as it requires that they be captured first).

D. For experiments that may cause mental, physical, social or ecological harm, research must be approved by an appropriate review board using the following criteria:

    1. experimental protocol should not be approved if an alternative with less harm is available and equally effective;
    2. such harm must be justified by demonstrating that the probable benefits to science, society or nature should clearly outweigh the foreseeable harms to animals or ecosystems

[56] For example, the Animal Behavior Society, Ecological Society of America, American Fisheries Society, and American Society of Mammalogists have committees on professional ethics and established codes of professional conduct for their members. The Society for Marine Mammalogy and European Cetacean Society have not released ethical guidelines for their members.

E. Adhere to the "three Rs" --reduction, refinement and replacement:

1. Use the fewest number of animals required to demonstrate a specific level of effect. However, in implementing this goal, researchers will need to take into account the need to achieve adequate sample sizes from both sexes to cover the full range of ages and motivational states as is required to demonstrate a specific level of effect, and to produce statistically sound results to avoid or minimize ambiguity. This may not always be possible in field situations, especially in exploratory research where power analyses cannot be used to predict the required sample size in advance.
2. Minimize all impacts (biological and psychological), recognizing that the latter is in most cases very difficult to predict and measure, but should be addressed to the extent practicable) on all animals potentially affected by directed research.

3. Optimize the use of alternatives to the direct use of animals.

F. Require the involvement of highly trained researchers to ensure proper and protective implementation of research techniques, although the need for younger scientists to gain knowledge and experience under appropriate supervision must also be considered. All researchers must assume responsibility for the humane treatment of experimental animals under their oversight.

G. All assistants in the research who might affect the subjects should have received instruction in research methods, and know how to recognize and minimize any adverse impacts of their activities, commensurate with their role in the research team.

H. Ensure that the research is not unnecessarily duplicative of previously published work (allowing for replication, which is an essential part of the scientific method).

I. Work to ensure that research results are not misused or misrepresented (*e.g.*, through invalid extrapolations, or conclusions that go beyond what the data show).

Specific Discussion of Ethical Issues for CEEs to Beaked Whales

A growing number of fora, including the ACCOBAMS Scientific Committee, European Cetacean Society, and the Marine Mammal Commission Beaked Whale Technical Workshop in April 2004 (Beaked Whale Workshop),[iii] have identified as a priority the need for research to develop a better understanding of the effects of anthropogenic sounds on beaked whales. This consensus has stemmed from agreement that analysis of sound fields from the best-studied cases suggested a low probability that the stranded whales could have been exposed to sound levels likely to cause direct injury based upon data from other species in laboratory settings. Exposure of beaked whales to some threshold of level and duration might trigger a behavior that could lead to a lethal stranding. Since behavior can be triggered at any level of sound that is detectable, it is critical to measure what exposures start to pose a risk of

behavioral disruption. This kind of CEE must be designed to minimize risk to the subject, and this risk must be balanced against the conservation benefits to the population for the potential information derived from the experiment. Given the growing recommendations for CEEs to beaked whales, we further discuss ethical guidelines here to help the Advisory Committee consider the bounds for achieving consensus about this special case.

The problem of understanding risk factors for beaked whales exposed to mid-frequency military sonars illustrates many of the ethical dilemmas raised in this document. As discussed in the report of the Beaked Whale Workshop, there is an association between naval sonar exercises and atypical mass strandings of several species of beaked whales.[iv] While we know that beaked whales have stranded within hours of sonar exercises, it is impossible to know what exposures were associated with a risk of stranding because we cannot know precisely where the animals were located when they were exposed to the sounds that led to the strandings. Educated guesswork and modeling can suggest a range of exposure, but these estimates are very uncertain. It is unknown whether sound from these sonars directly injures animals, whether it triggers a behavioral reaction that secondarily causes injury, whether injury and death are primarily a result of stranding, or whether there is some other explanation.

Even though there has been growing interest in the hypothesis that the risk to beaked whales stems initially from a behavioral reaction to sonar, there are alternate hypotheses that beaked whales may have some special vulnerability to sound, either to the auditory system or for non-auditory physiological effects. If sound directly causes injury at levels much lower than expected based upon data from other species, and if the injury would not be detected in CEEs, then CEEs would not be appropriate. Risks could be estimated with computer models based upon anatomy from dead animals, but ultimately the only way to test these models directly would be to conduct controlled tests on hearing or non-auditory effects on the species involved. Such tests would either require innovative methods with wild animals or bringing beaked whales into controlled conditions, probably in captivity. This document suggests a principle that CEEs should not involve exposures that could lead to injury. If we combine this principle with a refusal to extrapolate from different species, this would suggest that CEEs to beaked whales should not be conducted until after risks of injury have been quantified. Since beaked whales have never been maintained in captivity for long, this could take decades.

If the risk of stranding is related to exposures that evoke a risky behavioral response, rigid application of our principles for not conducting CEEs until we are certain about levels that cause injury directly could prevent or delay acquisition of data critical for protecting beaked whales from sonar sounds. On the other hand, results from CEEs may not provide information that is conclusive enough to clarify uncertainty and may result in no change in protection for beaked whales. Any policy to protect beaked whales from sonar will have to rely upon monitoring for and detecting whales near planned or ongoing operations. However, beaked whales are difficult to detect visually, and other detection methods are in early phases of development and thus not readily available. A critical parameter needed to protect these whales is to know the safe exposure zone. This is particularly difficult to estimate until we confirm one of the many hypotheses about the cause of the strandings.

One solution to this dilemma would be to simultaneously move ahead with low level CEEs along with research on risk factors for direct injury. An initial phase of CEEs could use levels below those reasonably expected to pose a risk of direct injury. Such a level could be discussed and estimated in a planning workshop. The properties of the stimuli used in these initial CEEs should be selected to minimize risk to the subject while maximizing sensitivity for detecting the start of reaction that could, if prolonged pose a risk. We know that beaked whales take many minutes to surface from their deep foraging dives. As long as their behavioral responses are not prolonged well beyond the sound exposure, this would suggest first exploring responses to short sounds starting at low levels up to an endpoint determined by such a workshop. If there is great concern that a short stimulus might elicit a prolonged response, this could be tested in an initial phase of the CEE. If a response is seen that might, if prolonged, pose a risk, the CEEs should be halted for that subject. If not, the duration of exposure might be lengthened at the endpoint level. Once a certain number of subjects are tested for onset of risky behavior, the analyses should be publicly reviewed before more exposures are proposed.

Beaked whales are difficult to sight, and methods for passive acoustic monitoring of their sounds are in the early phases of development and testing. This heightens concerns about ensuring that no undetected animals are closer to the source than the subject of the CEE. Not only should this work be conducted under excellent sighting conditions, but ideally should also involve passive acoustic monitoring of the study area in real time. It may be possible to use such passive acoustics to monitor beaked whales during actual sonar exercises, but the risk to the whales may be reduced and the information gained maximized by controlled vs. uncontrolled exposures.

The Advisory Committee needs to discuss the optimal mix of monitoring and mitigation measures available right now for beaked whales, along with the balance of research required to understand and reduce the risk of sonars for beaked whales.

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[i] Taylor *et al*. 2000
[ii] Cox *et al.* in review
[iii] See Cox *et al.* in review
[iv] Cox *et al.* in review.